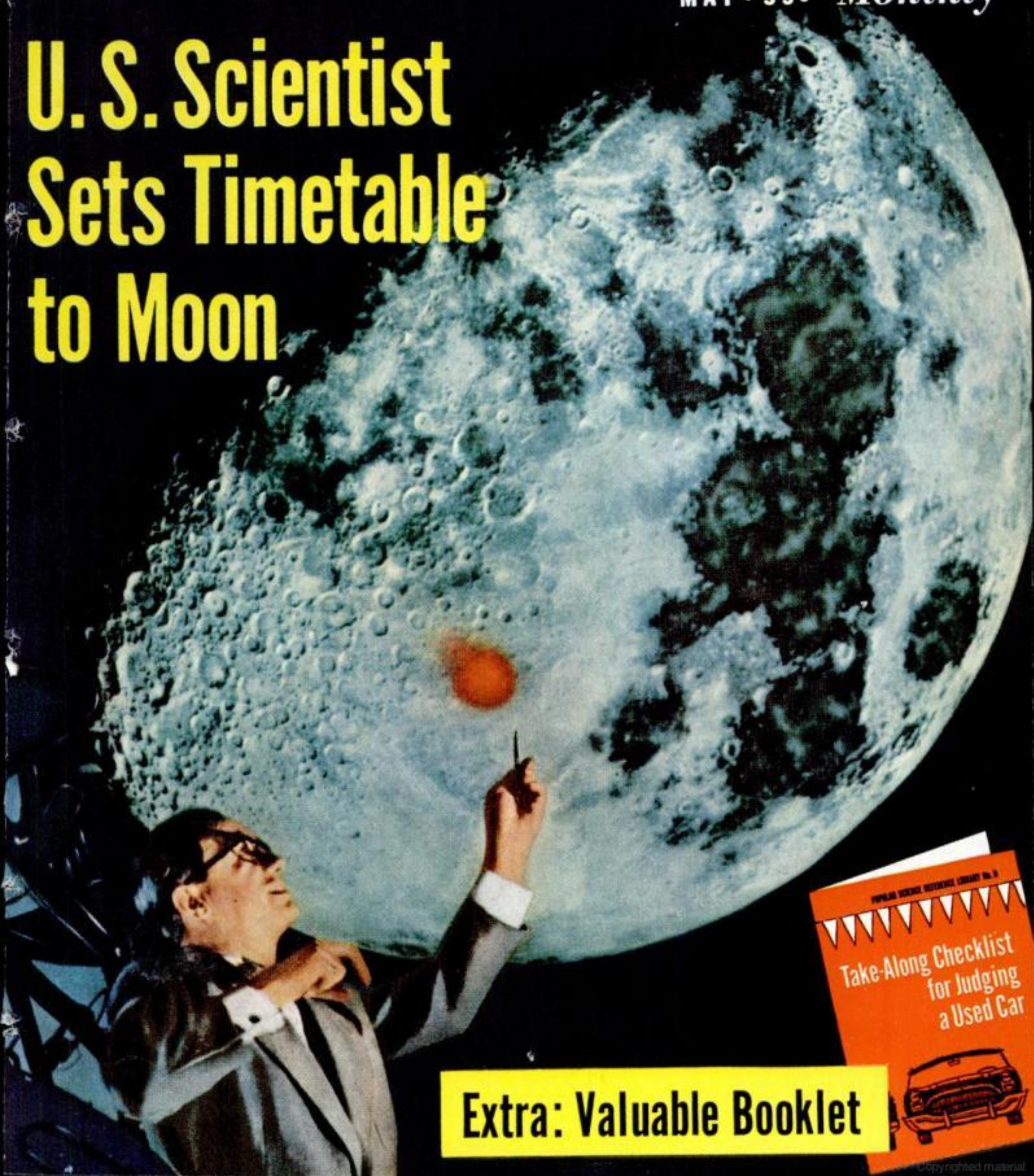


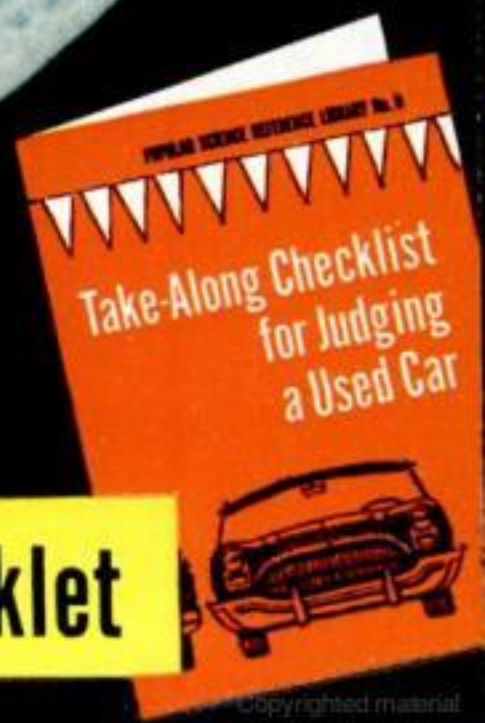
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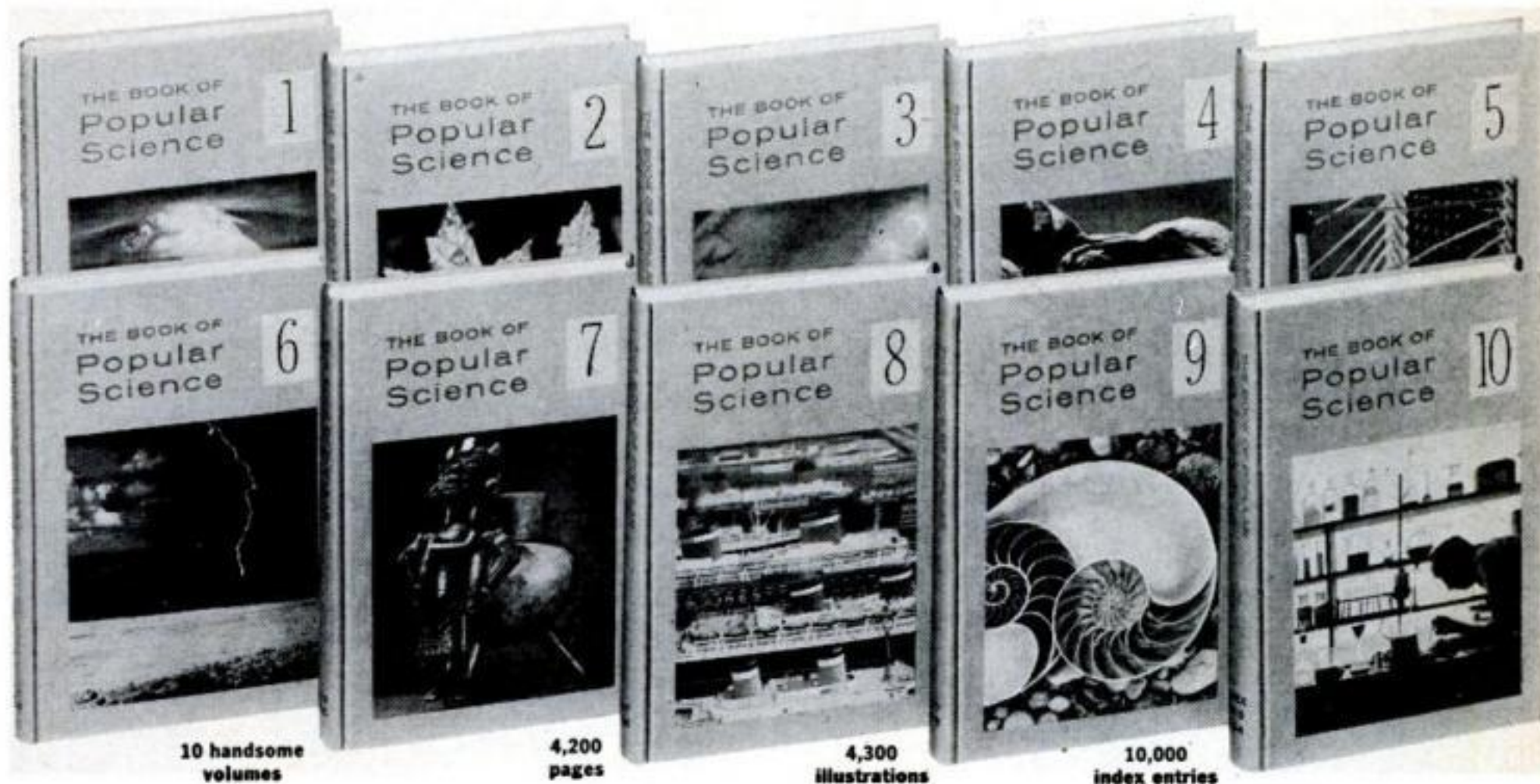
says Charles J. Rockwell, of Paramus, N. J., after waxing his '56 Plymouth with Du Pont New Car Wax. "Rocky" found that this new paste wax is as easy to use as a liquid polish, because it cleans, waxes and glazes—all in *one easy application*. And it protects with real Carnauba wax, *the toughest wax known*. Proof of protection is the long-lasting gleam. Six months, 10 car washings later, the finish still shows clear reflections of "Rocky" and his wife! Try Du Pont New Car Wax—it makes any good finish look new. At service stations and auto supply stores. Only \$2.00.



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Popular Science Monthly, May, 1958

Popular Science Monthly

May, 1958



Look, no hands! Will the car in your future drive like this one, guided by radio? PS gives you a peek at tomorrow



We're closer to getting to the moon than you may think, says Dr. I. M. Levitt (above and on front cover), director of Philadelphia's Fels Planetarium. Here's the schedule

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PS Readers

TALK BACK

Studying by Mail

THE February article "Plain Facts About Correspondence Schools" inspires me to add my own few words. Recently I signed up for a course in accounting and I have never once regretted it.

Home-study courses aren't miracle drugs. They can't teach you what you are



unable to comprehend, and they demand a great deal of time and effort. But I don't know of any better way for a man to spend his spare money or his spare time. After all, he is investing in himself and in his future. I would, however, recommend caution to those who might choose a course too remote from the type of work they are doing or beyond their educational background.

DAVID R. HANDS, Ottawa, Ont.

... I have completed a radio and TV course by mail in two years of hard studying. I gained a lot of theoretical knowledge, and, with some common-sense thinking and the course's step-by-step instruction in different circuits, I have learned to do a job well. It would have been easier in a classroom but with a family to rear you have to stay on the job. Still, after the day's work there are four hours or more for studying each night. Without correspondence schools, I would never have been able to take the course.

M. CAMPAU, Pine Bluff, Ark.

Tomorrow's Engineers?

How about an article against the President's plan to stop federal aid to vocational schools? As the mother of sons who go to this type of school for pre-engineering training, I am deeply concerned. I think these schools are wonderful. Time is divided half-and-half between academ-

ics and courses in practical mechanics.

The head of one of the largest automobile concerns has said that if he were hiring the engineers, he would hire only those who had worked as mechanics for four years.

I hope many of your readers will write their Congressmen to vote against removing federal aid to vocational schools.

MRS. JAYSEN, NYC.

For some years the federal government has allotted a big share of its educational budget to vocational schools—roughly 15% of those schools' expenses.

The President's tentative budget does indeed omit further aid. But Congress has the final word and it has long been a warm supporter of vocational education.

New Cars 'Slapped Together'?

MAYBE the assembly lines could turn out a sturdier car if so much money wasn't spent on spying out the competition's next move [How the Auto Makers Spy on Each Other," Feb.].

Factory-built defects are the growing cancer of the automobile industry and the main reason why we have been getting less actual car value for more money each year.

R. BLAGDEN, E. Hampton, Conn.

Wanted: Sense AND Style

MAYBE the voice of the people will be heard in Detroit ["Are They Building the Car You Want?"—Jan.] at long last.



They talk about "standard" and "stripped-down" models, but isn't it about time that somebody made a "common-

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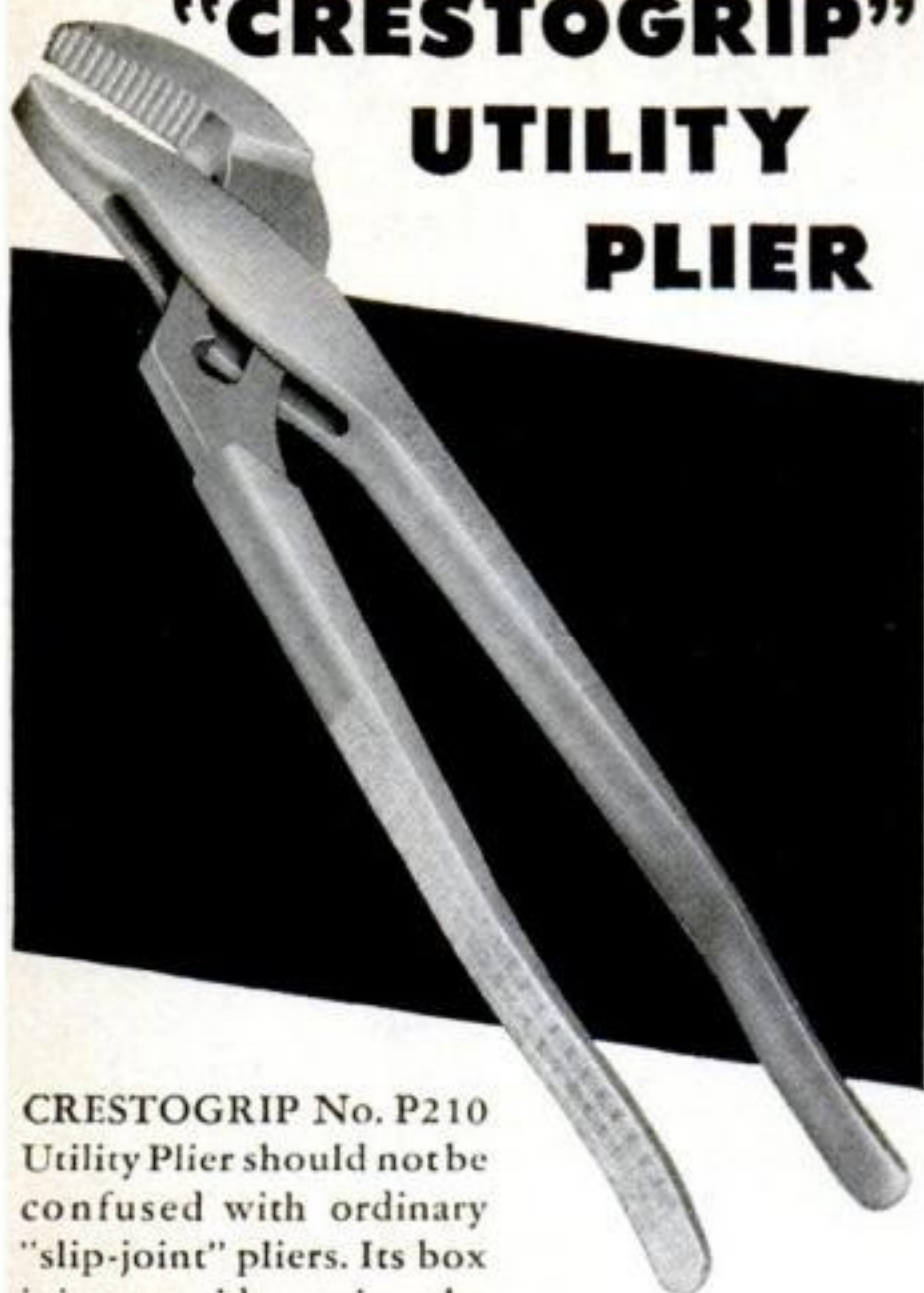
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sense" model—one that would have style in a conservative manner? How about a car that wouldn't start rusting through inside of a year, that wasn't so overloaded with grillework that the front end practically drags, and that doesn't need an ejector seat to get you out and onto the curb? And couldn't we get some locks that wouldn't freeze up in a sleet storm?

LLOYD N. BENNER, Brunswick, Me.

Plane-Guiding Guidance

TELL Donald Snyder, who wants a jack plane with an extension ["I'd Like



to See Them Make," Feb.), that the Bratton Co., Edwardsville, Kan., has a better invention than his for this purpose. The Squar-Ezy plane guide, it has a roller that moves along the face of the board.

RONALD H. HALL, Bethel, Kan.

... One of the tools we sell, the Handyman's Helper, is just the tool Donald Snyder ordered. It not only does what he asks for, but allows beveling at any degree and fits any plane, right- or left-handed.

Fox of Green Bay
Green Bay, Wis.

... I have been using an extension on my plane for over a year and use it for planing doors. I made it from a scrap of aluminum and a piece of ¼" plyboard. It's no job at all to make.

THOMAS McLAUGHLIN, Cleveland.

On Lubing Car Windows

"How to Hunt Down an Oil Leak" [Jan.] makes one suggestion that will cause more harm than good: using oil in the window channels. This will soften the rubber cement and the felt it holds will be ripped loose. Powdered graphite is a much better lubricant for this.

Difficulty in raising or lowering a win-

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dow may be due to a too-dry balance arm on the regulator crossarms. To remedy this, remove the moldings and aim a few squirts of oil at the moving parts. But don't use too much oil or you'll be cleaning it from the door sill for weeks.

WALTER SCHAEGLER, Newark.

When Is a Mortgage Too Big?

"WHAT Can You Afford to Pay for a House?" [Feb.] should be illuminating to future homeowners. But there is a point you neglect which much concerns me when I interview a customer for a mortgage.

Your formula is fine, but living ex-



penses change. Many newly married couples overlook the facts of life, think of today's expenses and forget that the mort-

gage will run 15, 20, 25 or even 30 years. During this time they may have several children to feed, clothe and educate.

Bankers get no fun out of saying "no" to a mortgage applicant, yet we feel that if we can show a customer his payments are too great for his pocketbook, we have protected him against foreclosure.

H. CURTIS FERRIS, V. P.

The Litchfield Savings Society
Litchfield, Conn.

Warm Words for Radiant Heat

You are so right when you say that "radiant-ribbon" heating [Hot-Water Heat Without Radiators," Feb.] costs less to install.

Four years ago I installed a hot-water system in my home. I used a large utility room—exposed on three sides—as an experiment. I ran two black pipes, much larger than the $\frac{3}{4}$ " diameter you mention, around the room and added a few air vents and a drainout system. It has been so successful that I would never consider changing this system. The temperature is at least five degrees warmer than the rest of the house.

T. R. PAURICE, Newton, N. J.



Engineer with a tough hair problem. Chemical Engineer Al Judson is troubleshooter at a giant Houston, Tex., plant. Sun, wind, steam mess up his hair.



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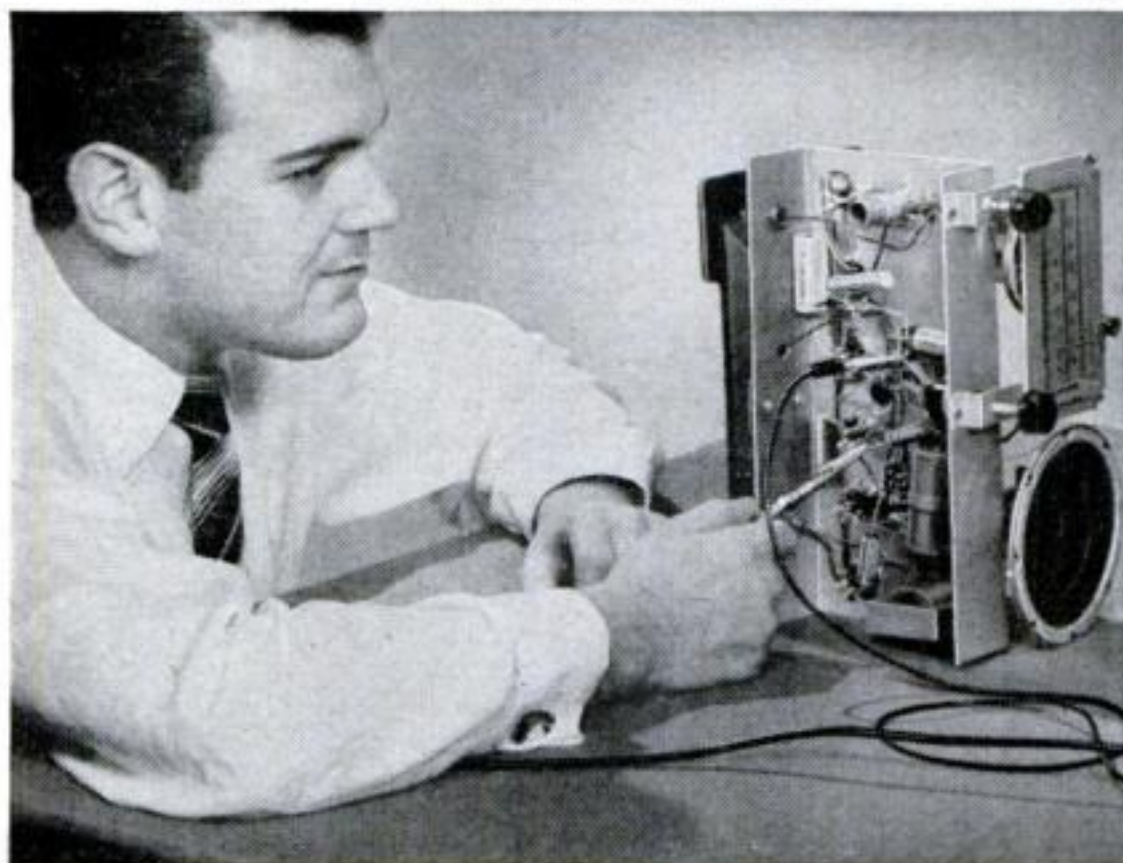
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at home in spare time for Radio-TV. With NRI 50-50 method, you study basic principles AND learn by practicing with actual equipment NRI furnishes. You learn with your hands and your head. You get dependable training, backed up by the reputation of the oldest and largest home study Radio-TV school.

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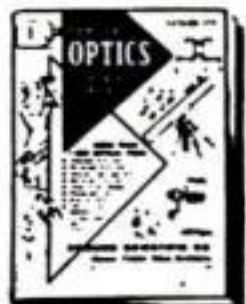


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The month in science

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Underground A-bomb. First reports on a new wrinkle in atomic testing suggest that many scientists and politicians will have to change their thinking drastically. Last fall the AEC set off a small A-bomb (the equivalent of 1,700 tons of TNT) 800 feet beneath a Nevada mesa. The results:

- ▶ No radiation escaped into the atmosphere.
- ▶ Earthquake-like waves were recorded on seismographs as far off as Alaska, 2,320 miles away.
- ▶ The blast crushed 450,000 tons of rock.

These facts could be highly significant. Consider what they mean: a) in our high-stakes poker game with the Russians, and b) for the future development of atomic energy.

- ▶ Tests can be harmless—no fallout to endanger present or future generations. A lot of people all over the world will breathe easier. And for the first time, we have a good counterproposal to the Russian demand that all A-testing stop. (AEC is also testing other schemes to prevent fallout.)
- ▶ International monitoring of tests seems promising. Earth waves would *probably* give away underground shots, brightening the prospect of effective policing for atomic agreements with the Russians. Doubt on this point, however, still triggers name-calling argument among top scientists.
- ▶ Commercial use of atomic *bombs* (as opposed to nonexplosive atomic furnaces) is feasible. An explosive that can crush 450,000 tons of rock with one shot would come in mighty handy for mining ore, loosening up oil trapped underground, or moving mountains that nature left in inconvenient places.

Even more exotic applications are possible, reported the AEC after it finally managed to drill back into the explosion center:

- ▶ Steam for power could be generated by piping water into rock heated by the A-blast. The drill holes revealed temperatures as high as 190 degrees near the detonation point—and this was four months after the bomb went off.
- ▶ Drastic heat and radiation treatment could be administered to materials planted around the bomb. The test blast hollowed out a 110-foot-diameter "glass ball" lined with molten rock, but it was quickly crushed by the weight of earth above it.

Does this mean that artificial diamonds, sapphires and rubies might be created from minerals in the ground surrounding the explosion? Some scientists think so. But the AEC's drillers found none this time.

TV without shocks. General Electric is first to Do Something about the possibility of electric shock from vertical-chassis TV receivers (industry action was forecast by PS last fall). New GE portables have one-way plugs: one prong is slightly wider than the other. If your house has matching outlets (very likely, for they've been standard for years), and if the electrician installed your wiring

The month in science

correctly (better check that), then this plug makes sure that the TV chassis is connected to ground. It provides effective, but not absolutely foolproof, shock protection.

GE also covered the metal cabinet with vinyl fabric. Main reason was appearance, but the vinyl does serve as insulation.

Could we shoot down enemy missiles? It's a little like swatting a mosquito in the dark with a paper clip. An ICBM can cover 5,000 miles from launching site to target in about half an hour. Still, the Air Force is betting a billion dollars that it can give 15 minutes' warning, according to *Aviation Week*.

The sentries will be three very-long-range radar stations making up an Arctic Warning Line. Each station will have two radars. One type, similar to those now used to follow our own (and Russian) test missiles, will monitor the air over Russia. If it detects something, it will aim the second set, Lincoln Laboratory's giant Millstone Hill radar. This type will decide if the intruder is a missile, then compute its path.

Actual shooting-down will be the Army's job, from anti-missile missile bases guarding key targets. Two systems are in the works.

- ▶ Nike-Zeus uses four radars: No. 1 detects the intruder, No. 2 latches onto it, No. 3 tracks it, and No. 4 helps guide the anti-missile missile toward it. Parts of the Nike-Zeus are already built and it could be on the firing line in four or five years.
- ▶ Plato also uses the Nike-Zeus missile but is mobile, with special launchers and truckborne electronic gear. It could be used overseas, or around U. S. cities to knock down sub-launched missiles.

How effective are such defenses? Present guess: They would miss three times out of four. One problem is decoys.

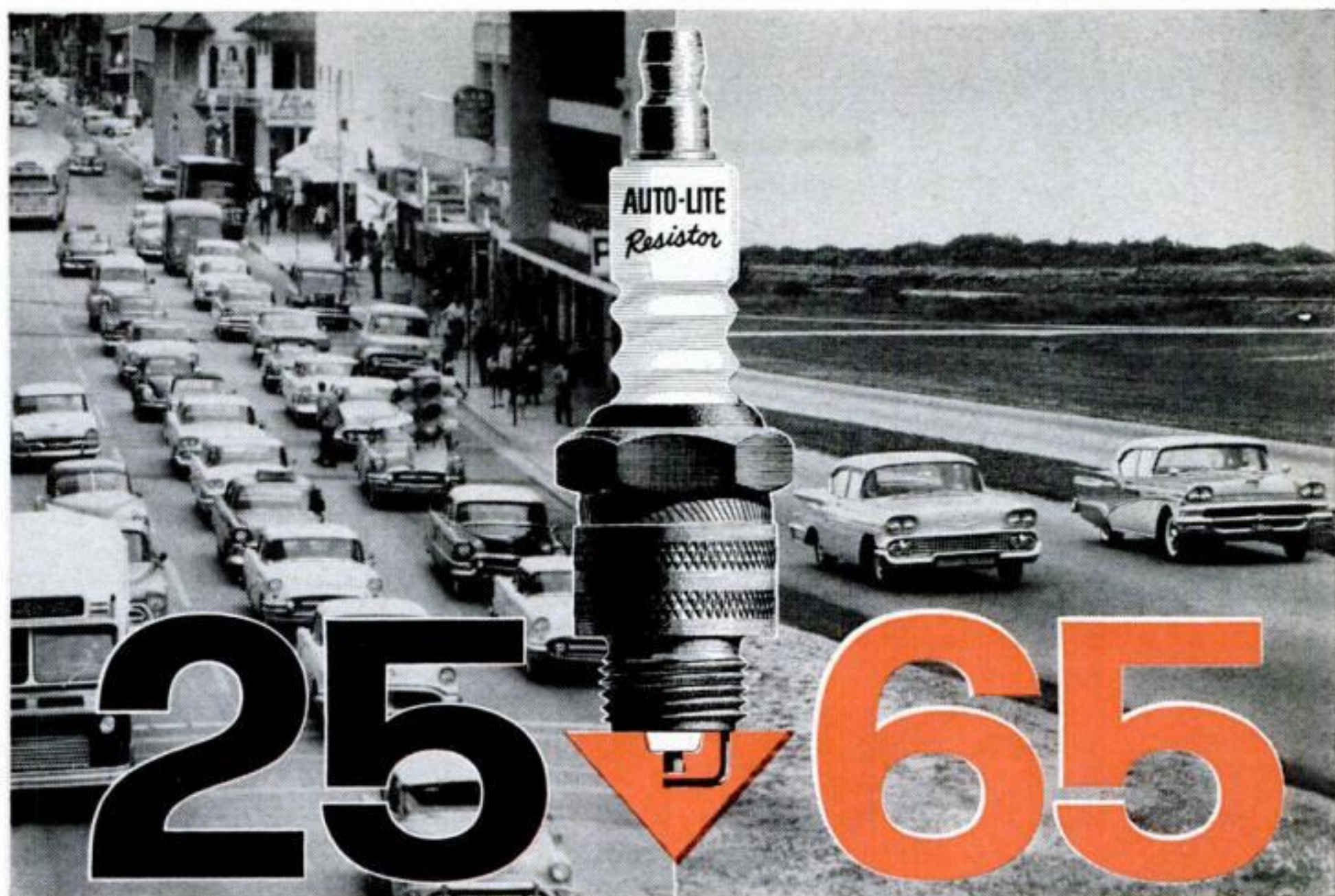
The Russians could separate the last-stage rocket motor after it had burned out, then blow it up to surround the warhead with a screen of fragments extending over thousands of square miles. To present radars, the harmless motor fragments would be indistinguishable from the lethal warhead.

These decoys, lighter than the warhead, would have less momentum and would be slowed down more by air on the way down to target. So at the very end, the warhead would be streaking ahead, alone and vulnerable.

But if the defenders wait for that, they get about four seconds to launch their anti-missile missiles.

Fingerprints away. It won't help crooks any, but those identifying grooves and ridges on fingertips can be destroyed, after all. Skin planing, with the high-speed electric wire brush used to remove facial scars, does it, according to Dr. James W. Burks Jr. of Tulane University. The skin surface that grows back looks like the web between thumb and forefinger. Fortunately for the cops, lack of fingerprints would look mighty fishy.

Walter Mann



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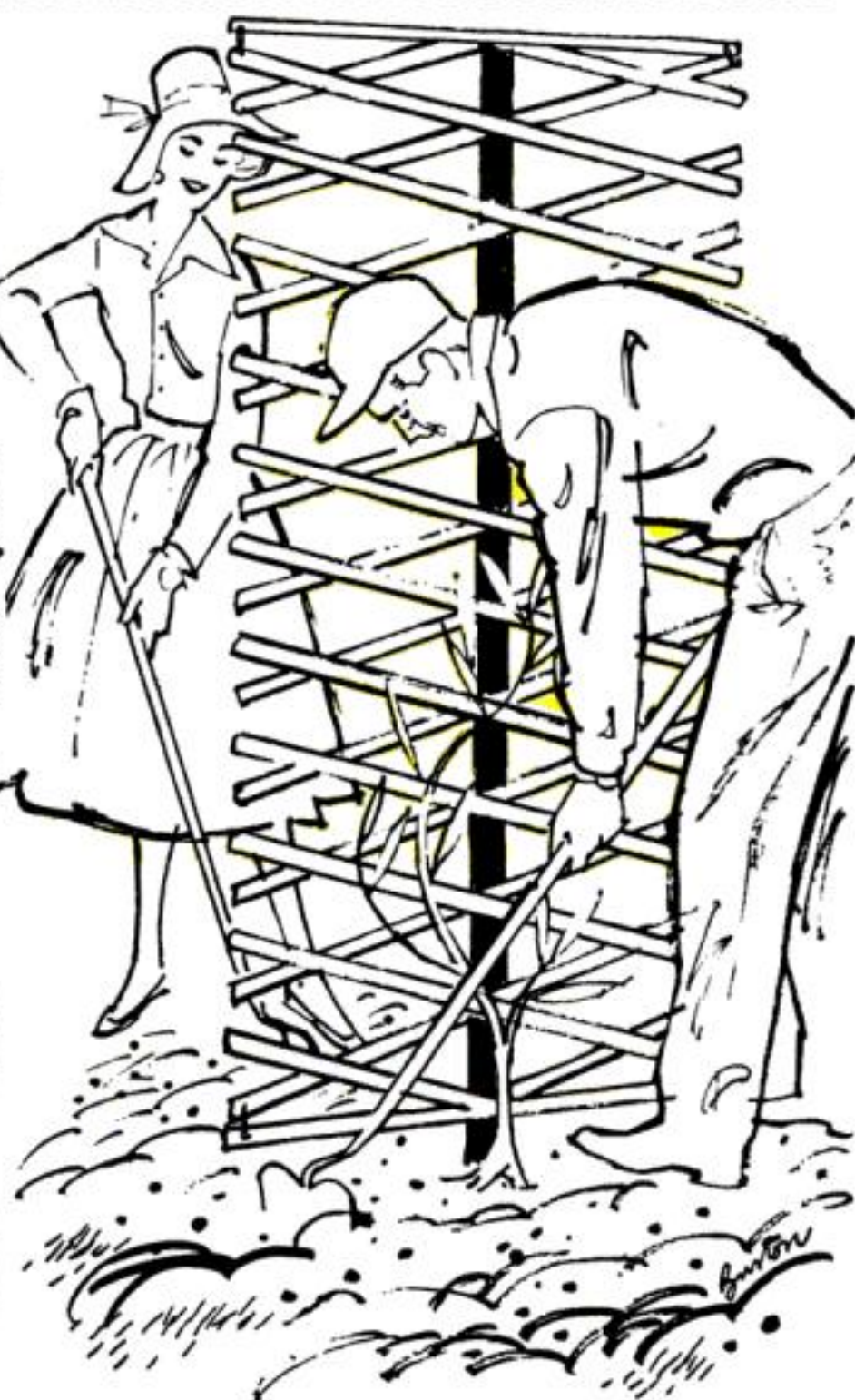
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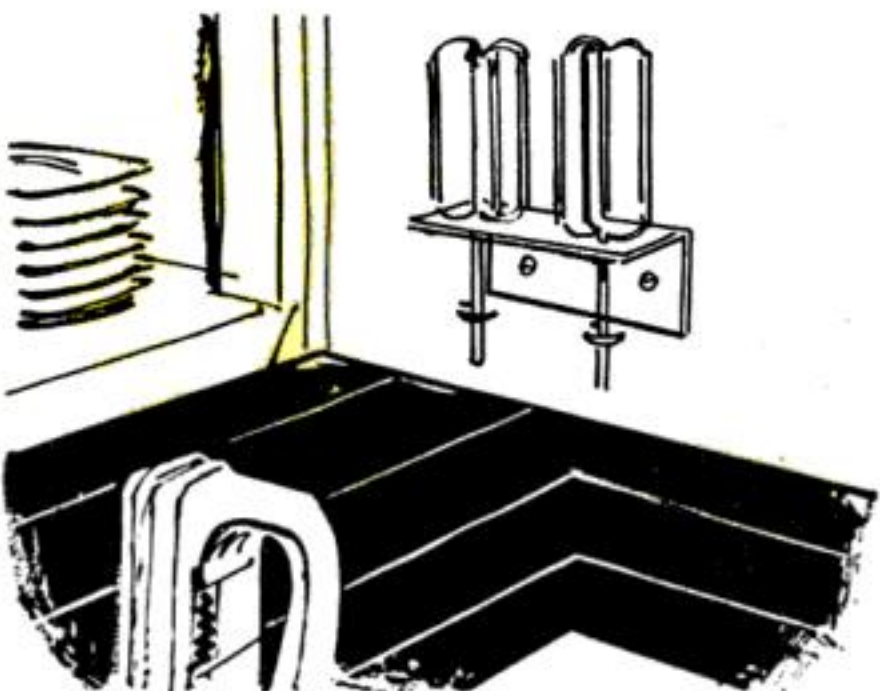
TO KEEP THREAD FROM UNWINDING, loop the end around a thumbtack stuck in the top of the spool. The tack is easier to see and to use than the tiny cut in the spool's rim.



BOTHERED BY WASPS? The N. J. State Agricultural Experiment Station says they become lazy homebodies at nightfall. While the wasps sleep, spray them with DDT or chlordane.



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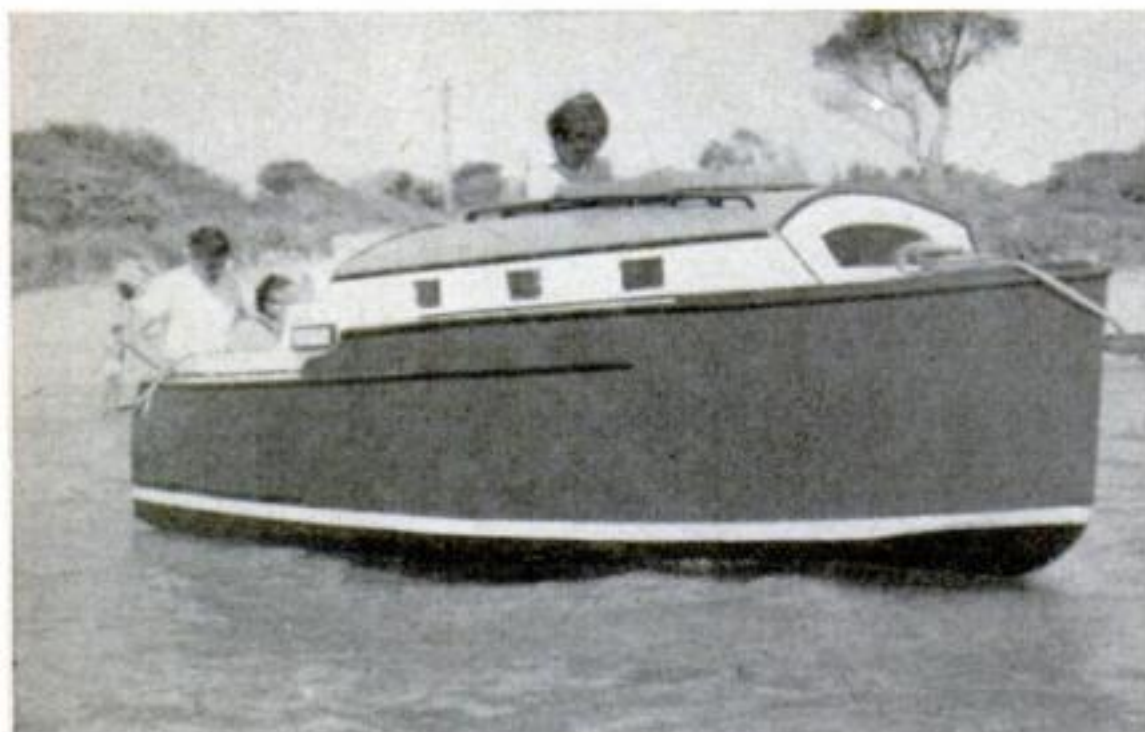
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Boat Draws Six Inches.

Piloted through the treacherous waters of Port Phillip, Australia, this 17-foot cabin cruiser often glides over sandbars just six inches beneath the surface—a feat matched by no others of its size in the area. Robert J. Amor of Frankston, Victoria, built it from plans in the February, 1939, issue of *POPULAR SCIENCE*. The curved cabin roof is laminated and resin-bonded. A 12-hp. outboard provides plenty of power for the seaworthy craft.



Transistor Radio. Though it looks like the work of a professional, this transistor radio (*PS*, July '57) is the first project to be built by Bill Conkie of San Francisco. His friends are amazed at the tone quality and appearance of the set, which is finished with 10 coats of jet-black lacquer rubbed to a high polish and protected with wax.



No-Mortgage House. The four-foot doorway and five-foot ceiling are just right for these two little girls posing in front of their own playhouse. Their father, George W. Hicks of Bainbridge, Ga., built it for them in his spare time with hand tools and a table saw. Features of the six-by-eight-foot house include a picture window, built-in cabinets, a table and chairs—all scaled down to juvenile proportions—and no mortgage to fret about.

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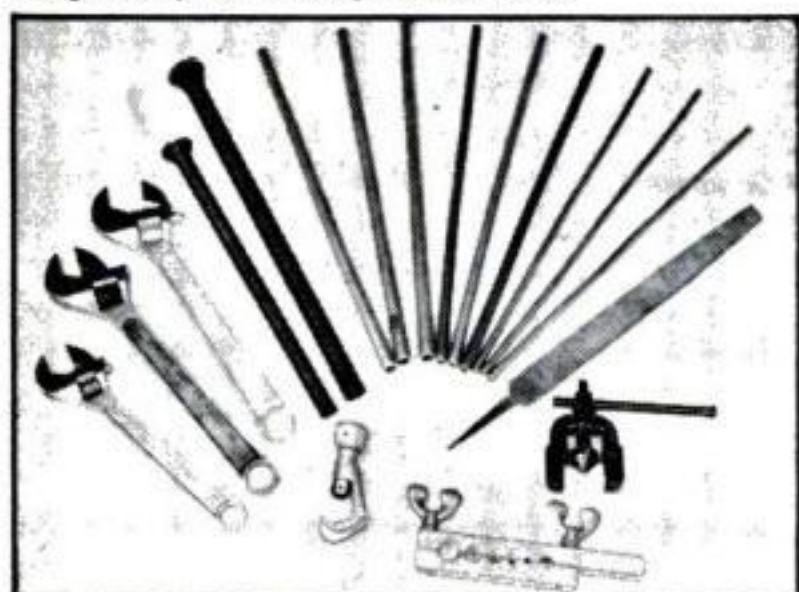
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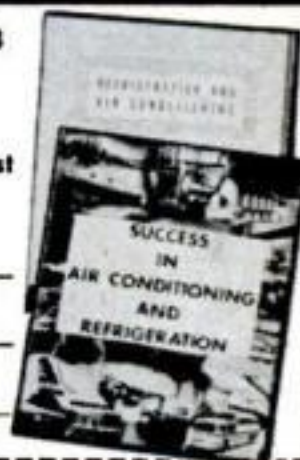
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CONVERTIBLE STATION WAGONS. Removable roof sections and rear windows would make them open cars in summer. They'd serve as open-bed trucks, too.—*Bob Marie, Hometown, Ind.*



EASY-TO-OPEN FROZEN-FOOD PACKAGES. Pull-strips like those on cigarette packages would make a simple job of getting at the sealed-in contents.—*Mrs. Chester Combs, Tucson, Ariz.*



GARDEN HOSES ON AUTOMATIC REELS installed inside the basement. They'd pay out or reel in hose like the extension cord on some appliances.—*S. P. Jacobus, Fairfax Station, Va.*



REAR-VIEW MIRRORS that can be easily re-aimed after they've been moved. Marked dials would let each driver of the car adjust the mirror to his own setting.—*J. Nathan, Winnetka, Ill.*

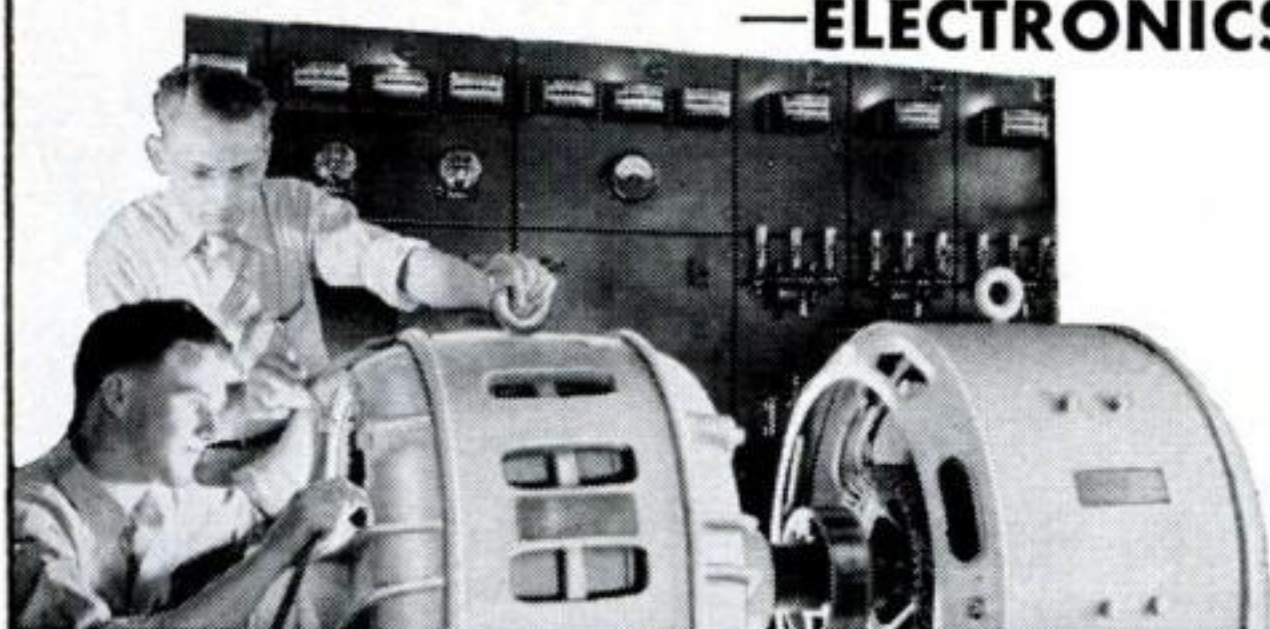
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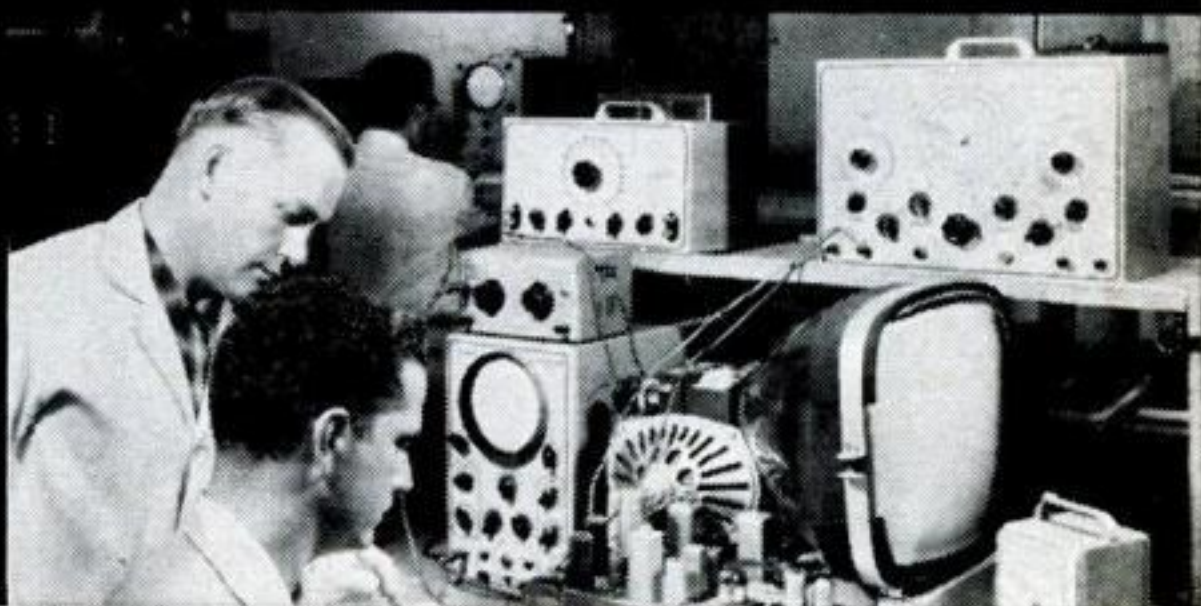
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Prices are weakening. Nothing to rave about. But almost everywhere—New York, Philadelphia, Detroit, Chicago, Los Angeles—product prices in the Popular Science Price Report have slipped or leveled out. Some late developments:

► Paint and tires have dipped a few cents, refrigerators are up a bit. And television prices—long in a steady climb—have finally lost some of their sting.

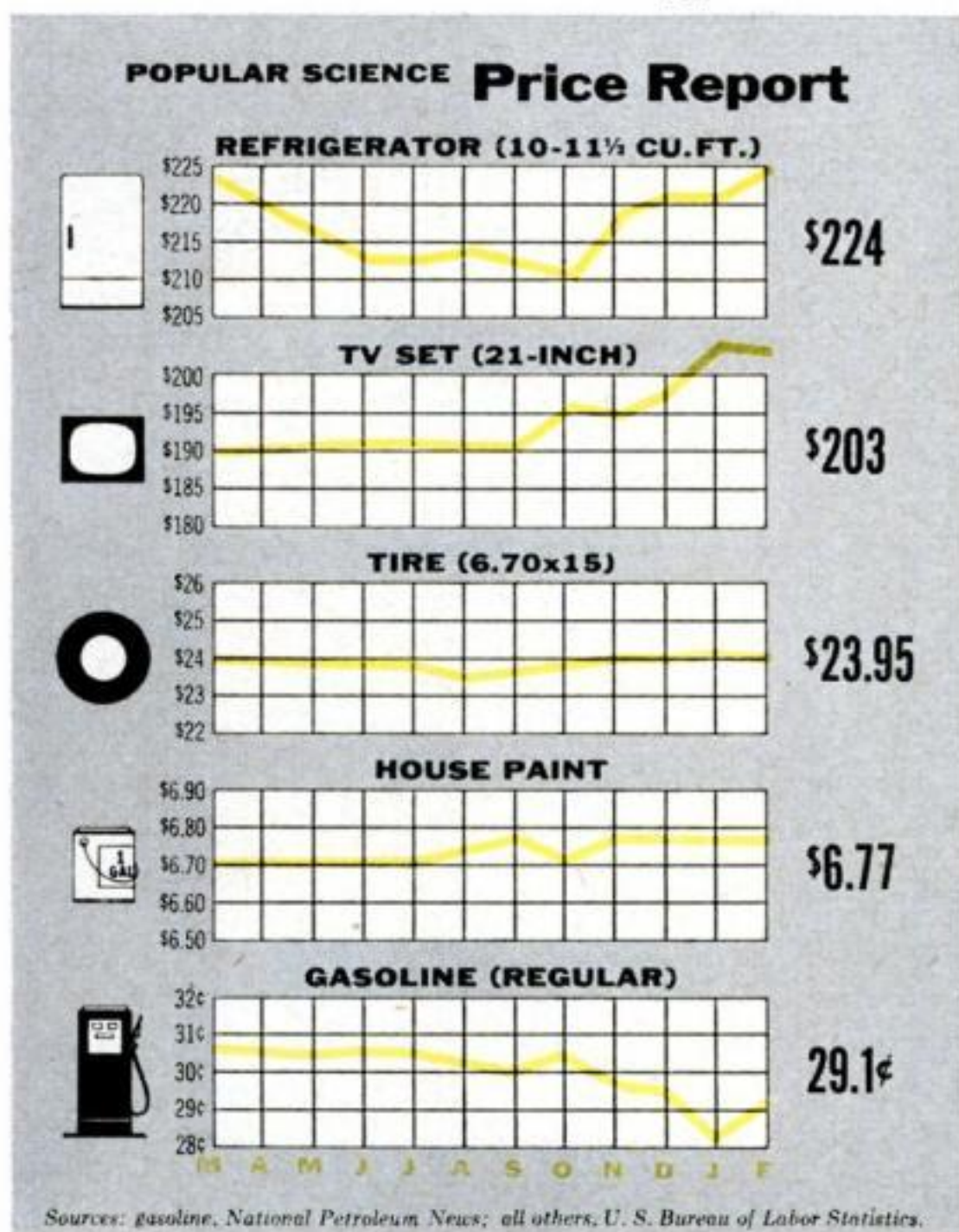
Regular and premium gasolines show one-cent price hikes in the industry's quotations, but if you live in some areas of New England, the Midwest or the Northwest, you may not yet have felt the effect. Local filling-station wars have provided bargains for motorists.

For regular-gas users in other parts of the country, all is not gloom: Record stocks on hand may keep gas prices from soaring much higher. But there seems to be little hope for owners of late-model, high-compression cars. Premium-gas costs

are heading toward even higher levels—especially on the West Coast. Reason, according to refiners: The octane race keeps boosting production costs.

- This month, only one thing kept the Price Report from dropping all across the board: Prices for television sets in New York spurted—an increase of \$4. That firmed the average TV price, because TV sales tags in other cities went down.
- By paring prices, manufacturers of some products hope to whet your appetite for buying. But don't play it cool. Don't hold off, hunching that another price cut is on the way. Retailers' price tags now don't leave very much room for profit. For any bargains in the future, the manufacturers will have to come up with cost-cutting gimmicks in production and distribution.

Dye your sun-baked grass? Green dyes, developed by the chemical industry, have been tested by Dr. Victor B. Youngner, turf and



You ought to know...

grass specialist at UCLA. His verdict: A good-quality dye won't hurt your grass, can last two to eight weeks. But you must still give the lawn an occasional watering. The dyes are available from garden suppliers.

Who is the boating hot-rodder in your family? This summer, don't point accusingly at Junior. You, the head of the family, are more likely to captain an outboard recklessly. The Outboard Boating Club of America, Chicago, rounded up statistics to prove it. Dad has all the earmarks of being accident-prone when he's afloat. Almost 70 percent of all boating fatalities are among men on fishing trips—their average age, 35. And their boats are usually either small-sized or large. Medium-sized boats—14-footers—have the best safety record.

- ▶ The quiet, pipe-smoking rod wielders are sometimes devil-may-cares at heart. They overload their boats. They stand up and move around. And they head into dangerously rough weather. All this runs up their high mortality rate. (Boat-going hunters, more cautious, have only a seven-percent accident rate.)
- ▶ The youngsters appear to have more sense than their elders. Sure, they're attracted to what might be called hot-rod boating: racing and water skiing. Both sports look dangerous. But they aren't. The accidents involving young people under 20 account for less than 10 percent of all mishaps. Possible reasons: better training and respect for boating regulations.

Actually, the waterways are a safe place to spend your leisure. The ratio of fatalities to outboards in use improves every year. In 1949, there was one death for every 2,100 outboards. Today, your chances of getting back to port are more than twice as good. Present estimate: one death for about 4,400 outboards.

Dialing long-distance calls nationwide? It's a dream halfway to reality. That's the latest progress report from American Telephone & Telegraph Co., parent of the Bell Telephone system.

Bell has been soldering in more transistors and relays so that, eventually, you'll be able to dial direct to any of 62,000,000 fellow phone subscribers. The project, begun in 1950, calls for 300 big switching centers spotted around the country. A switching center picks your call from an incoming long-distance line and feeds it to the right outgoing line. It gets around having an operator link the two lines by hand.

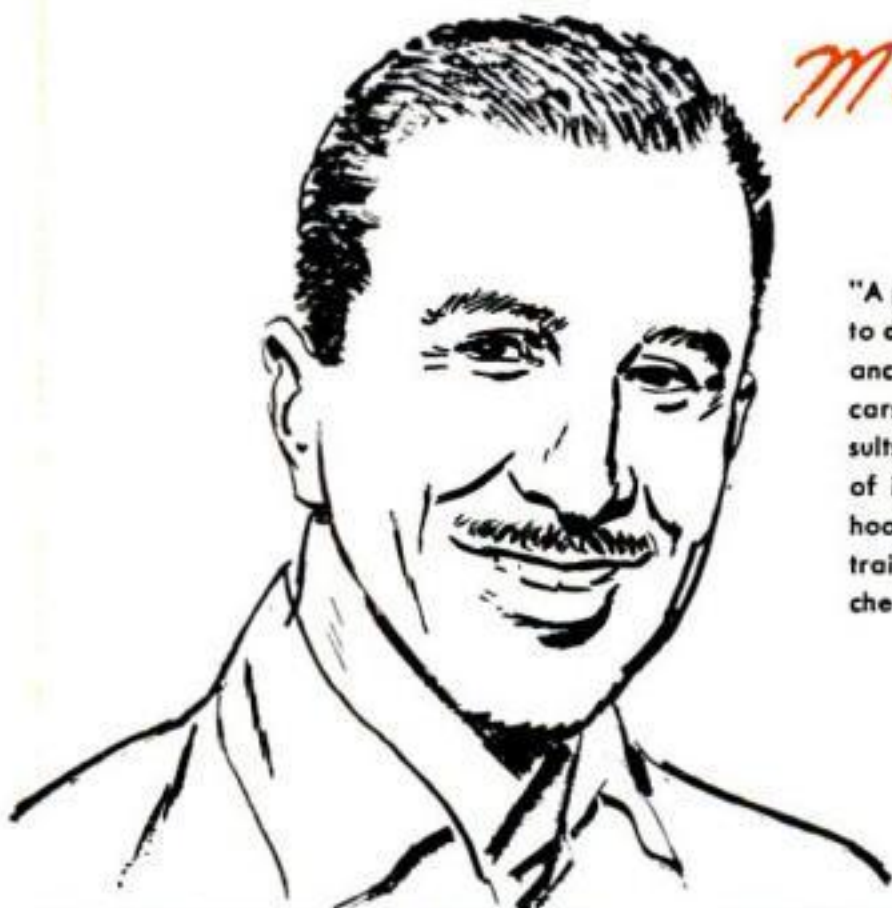
Half the centers are already clicking away, routing calls. Within 10 years—maybe five—the rest will be in business.

Telephone engineers are leaving room for future foreign business, too. They plan tie-ins with three phone systems outside the U. S.: Europe via the new transatlantic phone cable; Hawaii over the Pacific cable; and Canada, which has 5,000,000 phones in service now.

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Charles M. Garvey

"There's more than one way to improve your gas mileage"



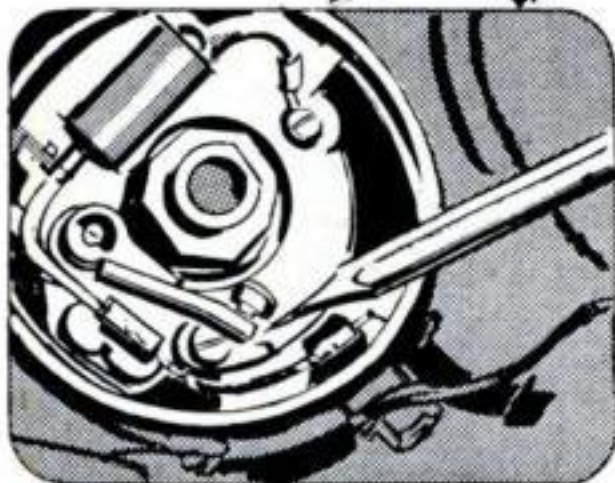
Mauri Rose

—experimental test driver and automotive engineer.

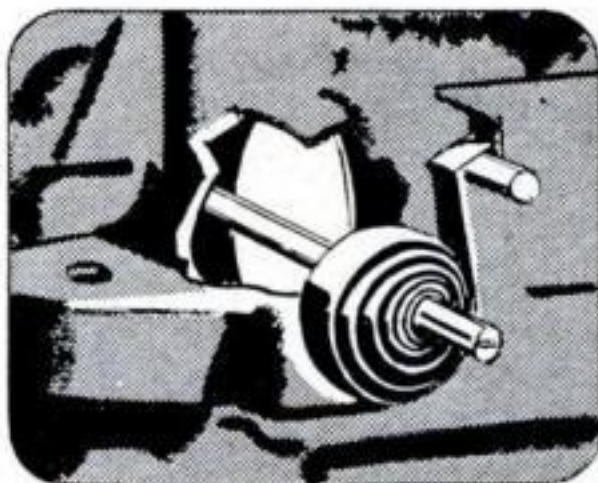
"A professional driver has a lot to do with getting top performance and economy from new cars he tests. But, the best results also depend on a number of intricate systems under the hood. That's why he relies on trained mechanics for needed checks and adjustments."



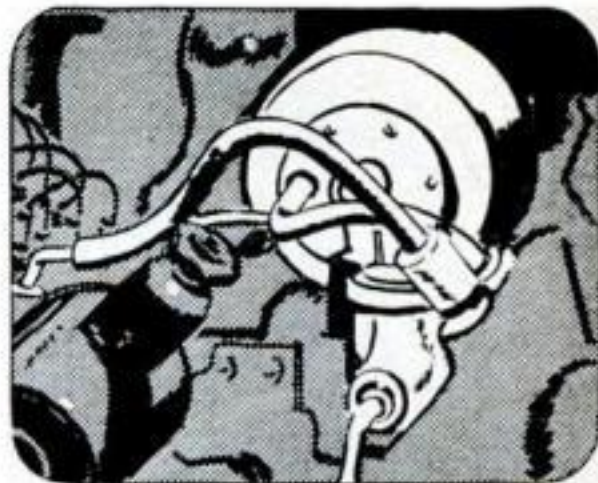
"Worn spark plugs could be a source of power and fuel loss. Electrodes must be clean, properly gapped and free from corrosion. New plugs at least every 10,000 miles is best."



"A pro always makes sure distributor points are clean and set at the proper distance for best performance. Arcing or cracks in the cap may develop to further decrease gas mileage."



"A trained mechanic checks the manifold heat control valve for possible trouble. A valve that's stuck open delays proper vaporization, a closed valve creates a loss of power."



"The vacuum system must be examined and connections tightened. Air filters should be cleaned. Clogged filters or air leaks upset mixture ratio and cause rough idle and fuel loss."



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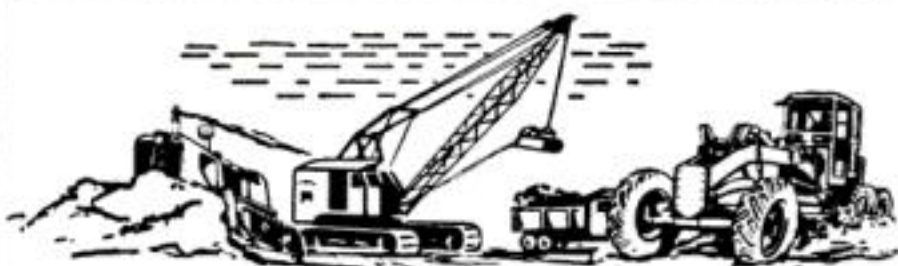
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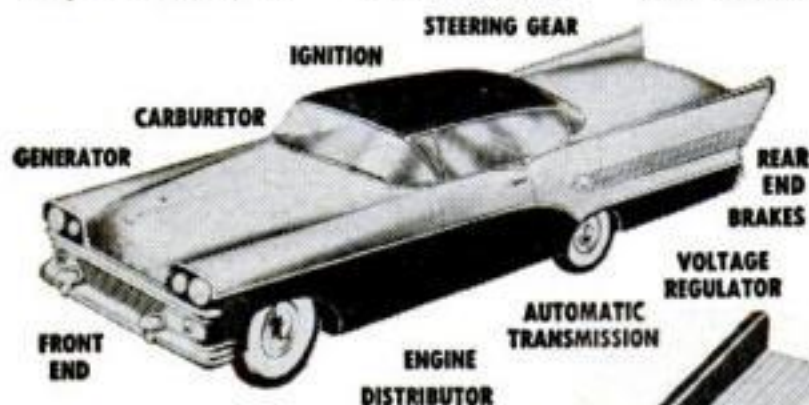
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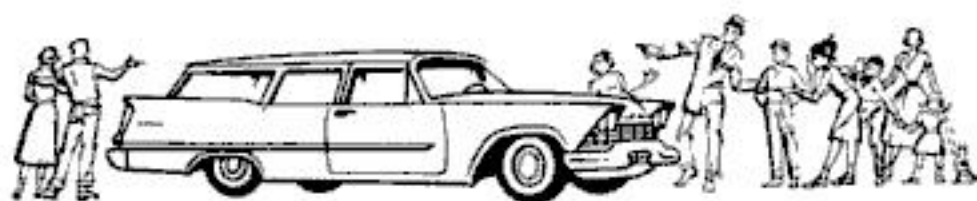
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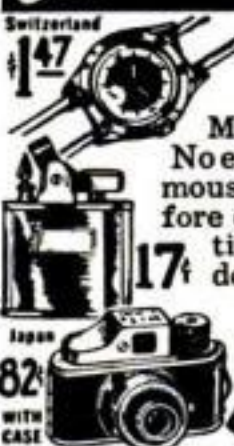
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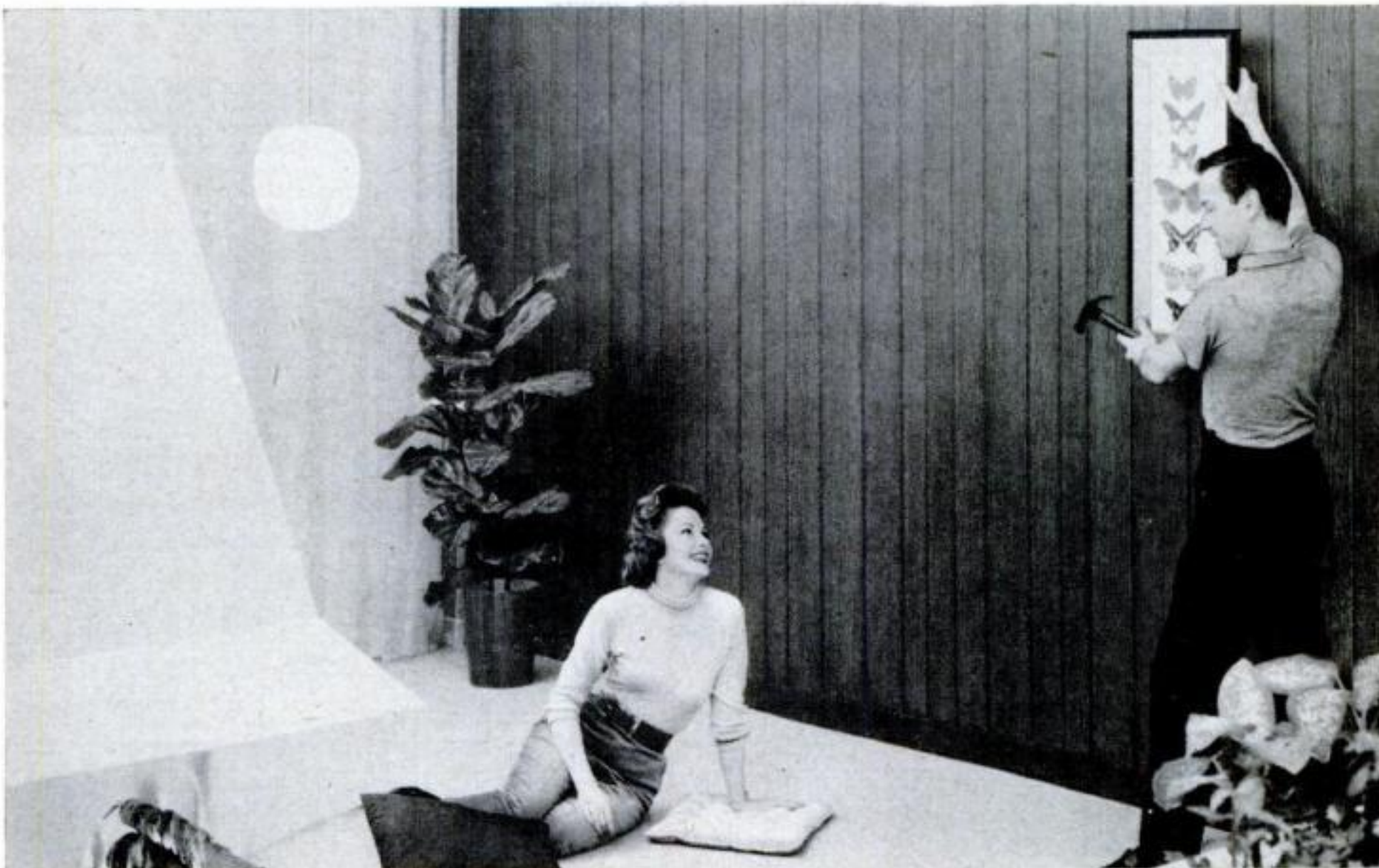
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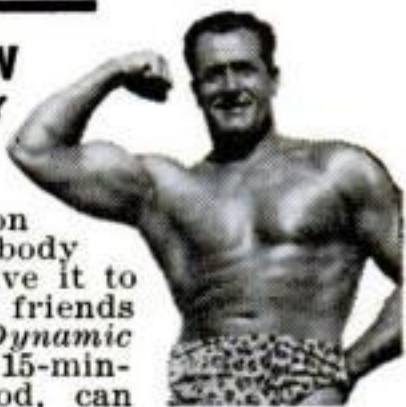
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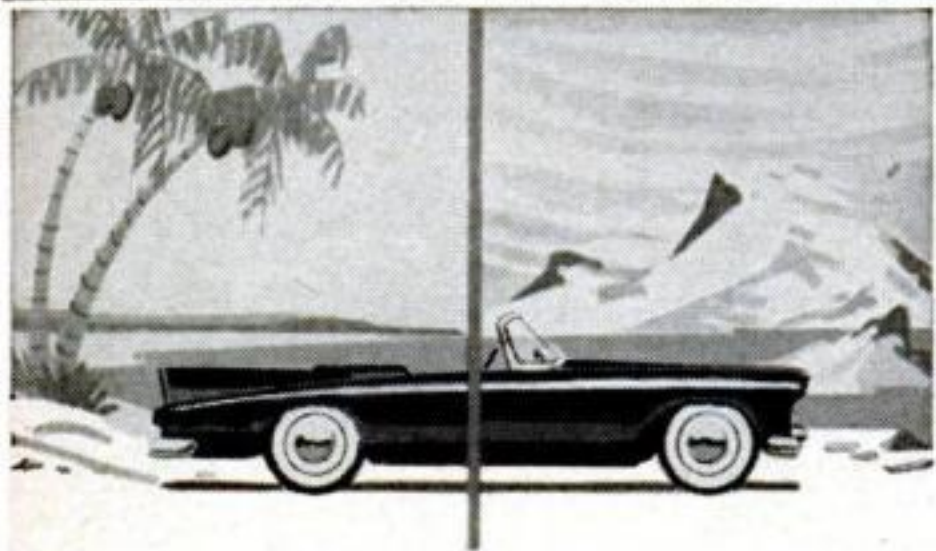
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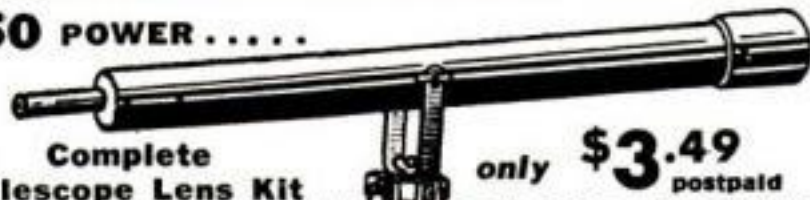
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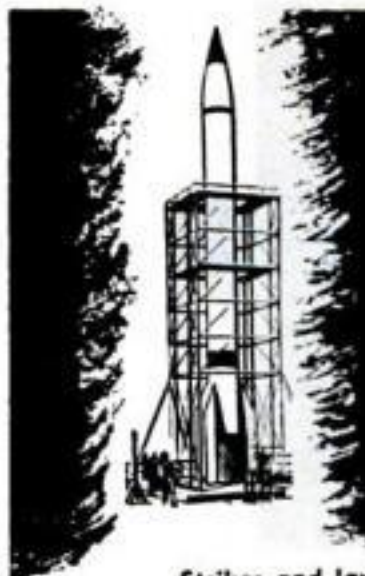
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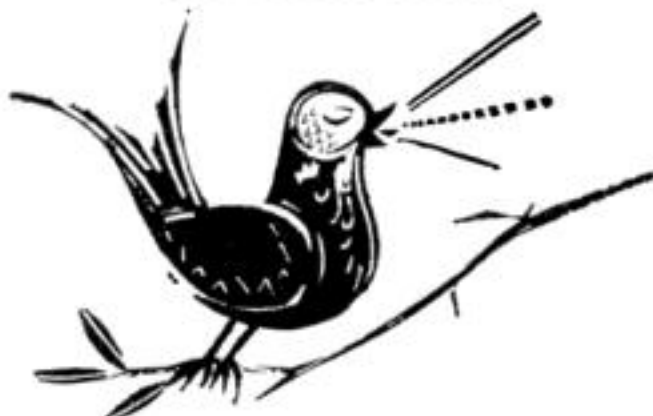
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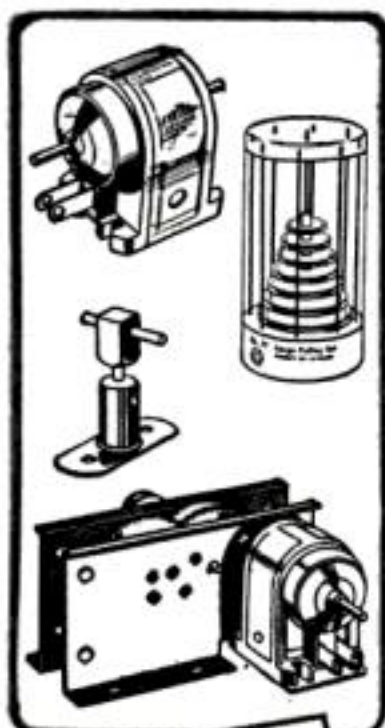
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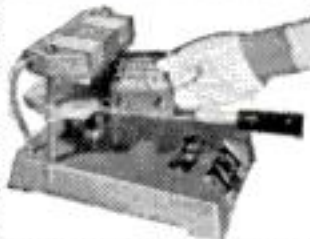
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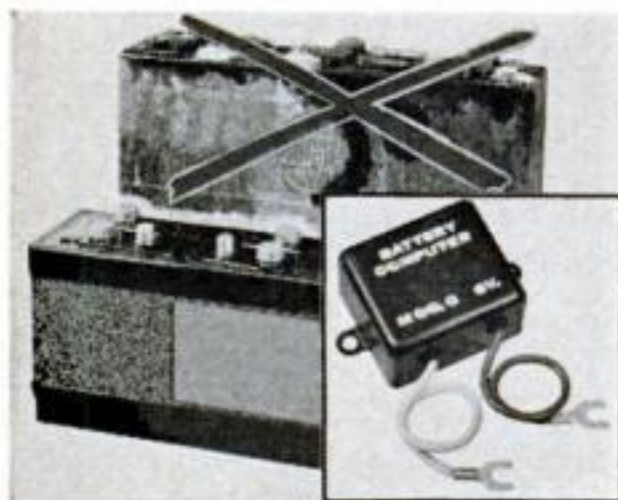
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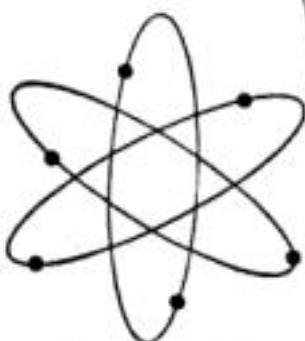
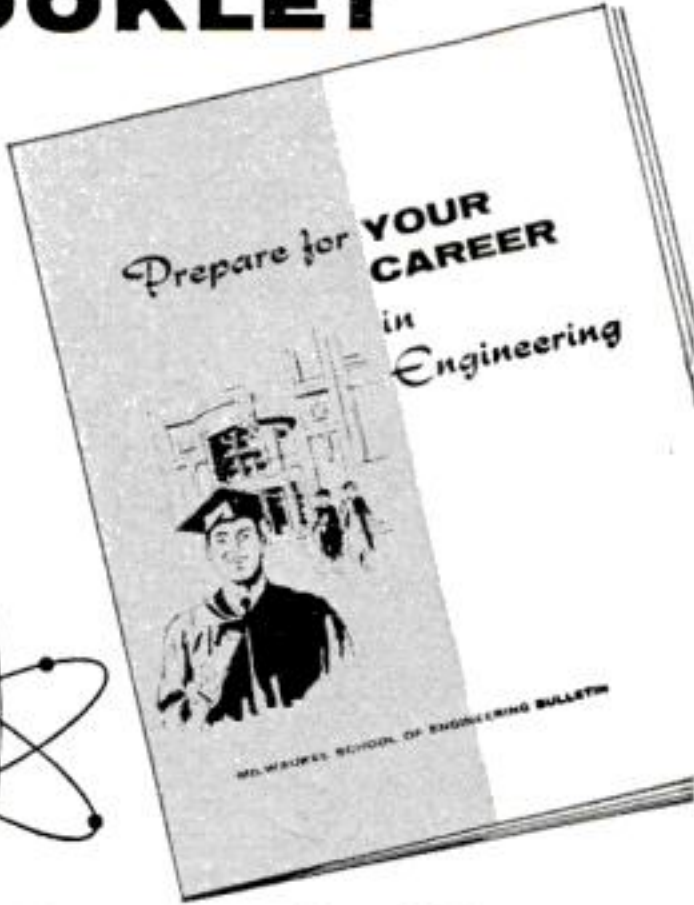
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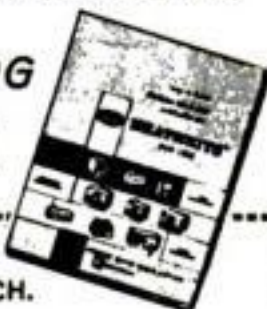


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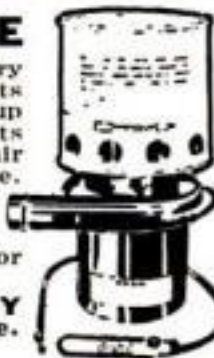
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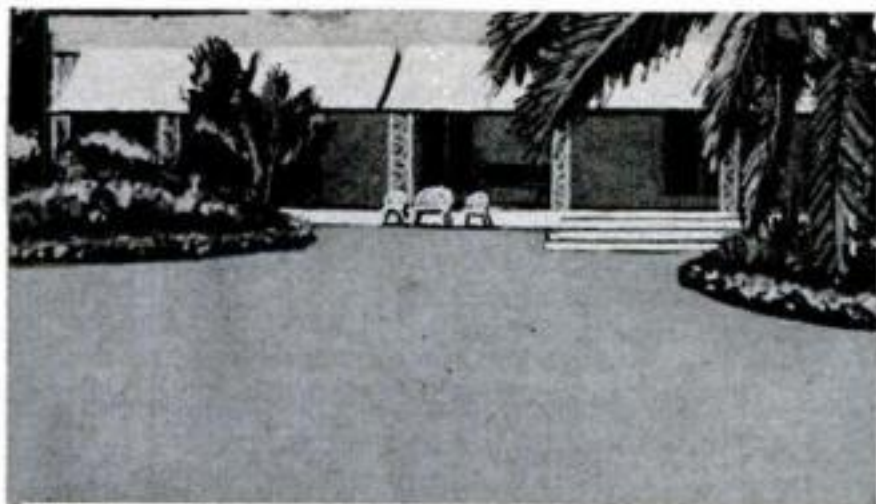
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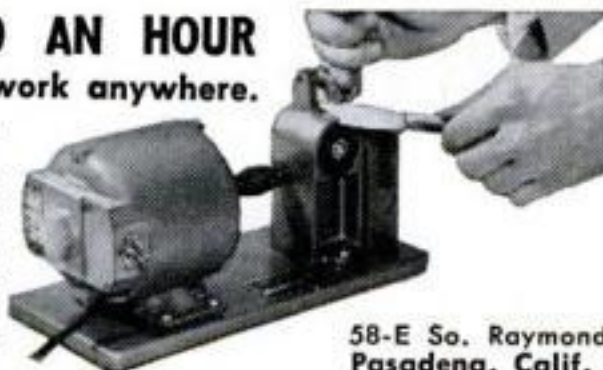
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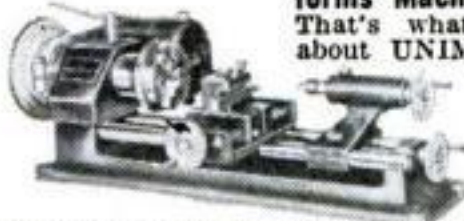
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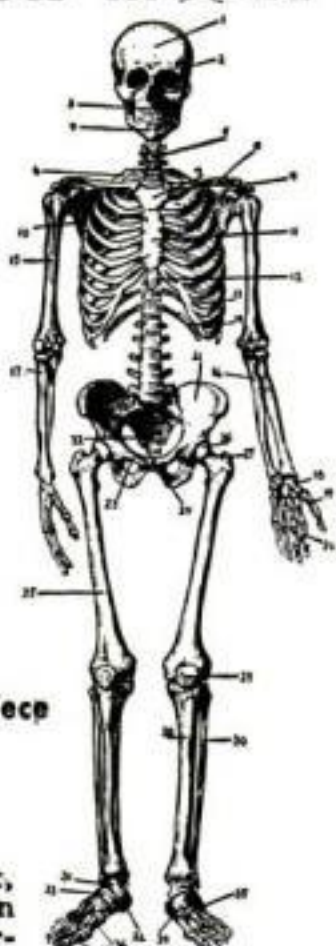
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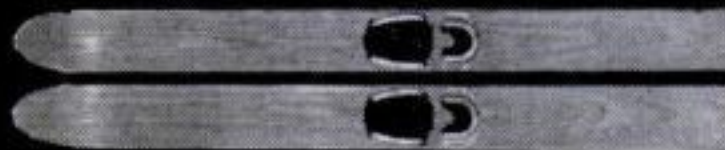
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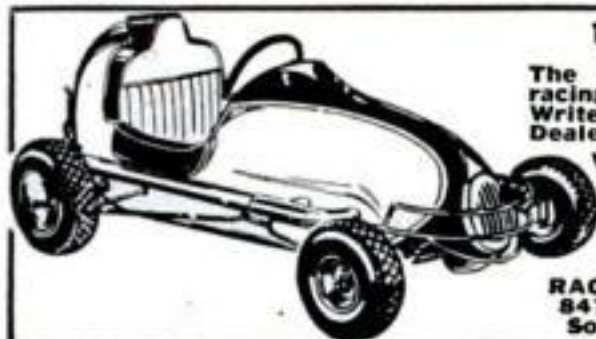
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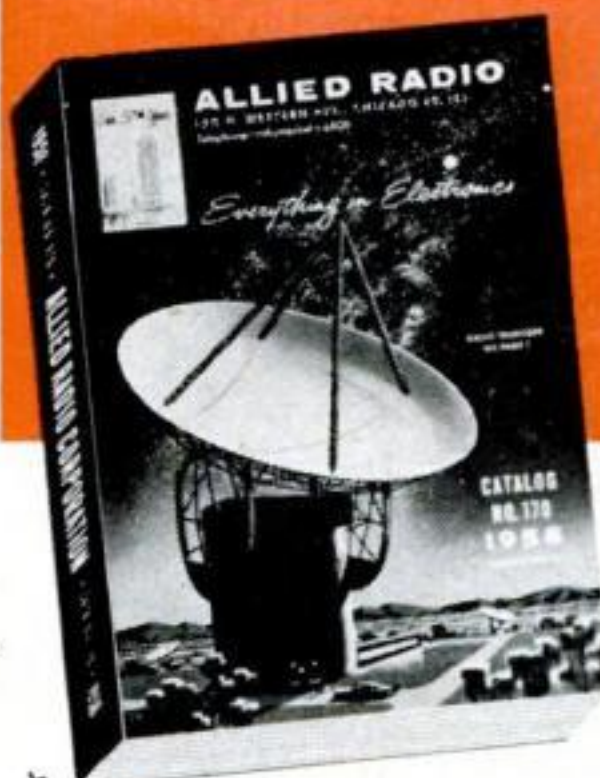
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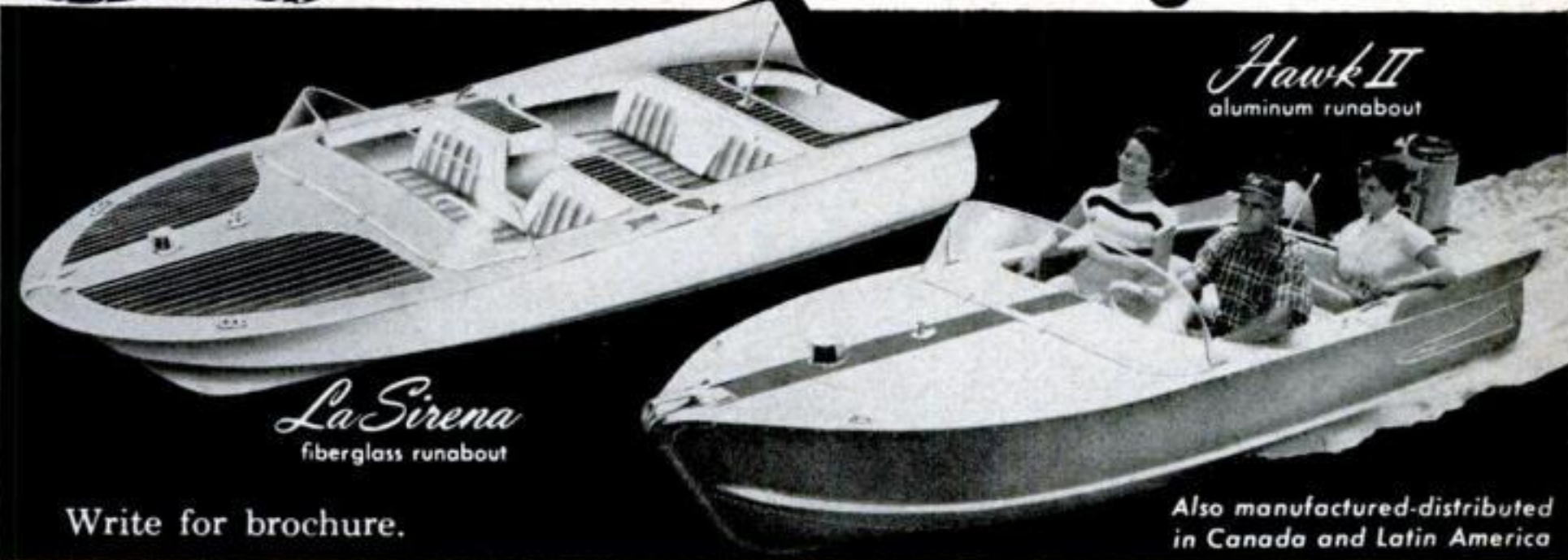
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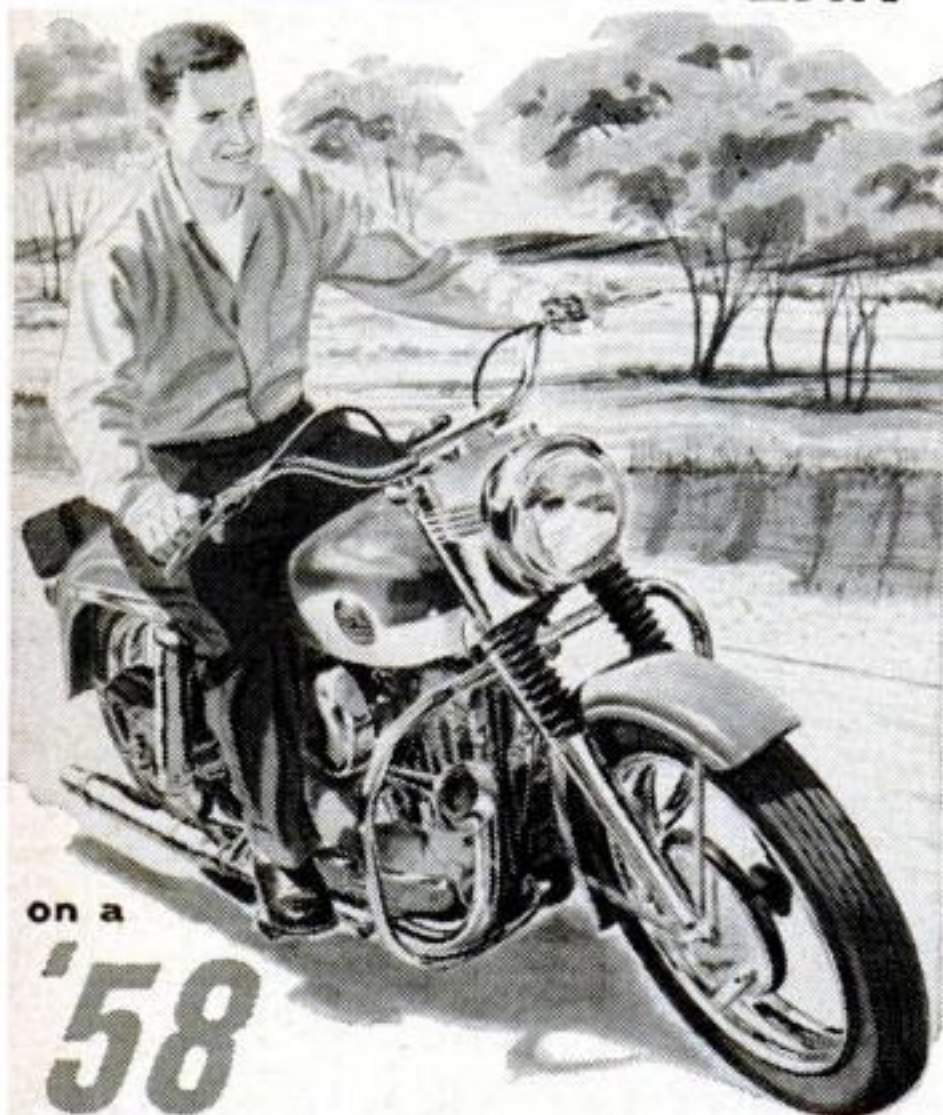
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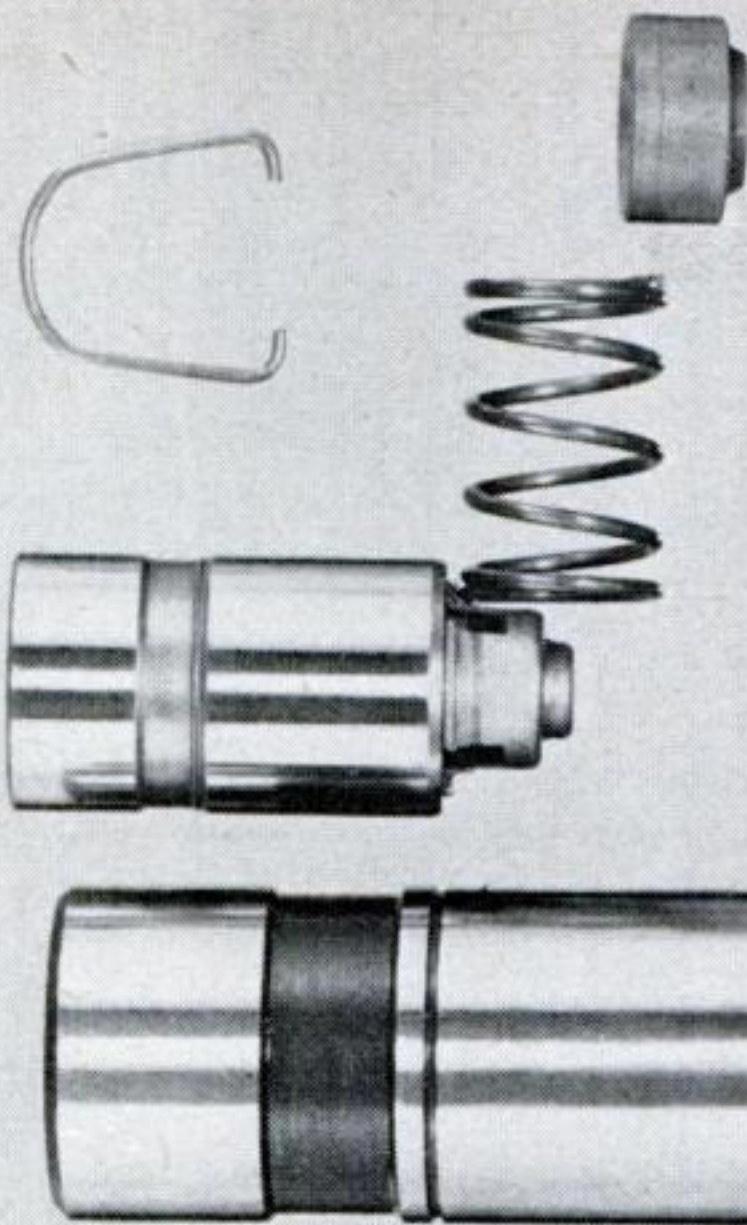
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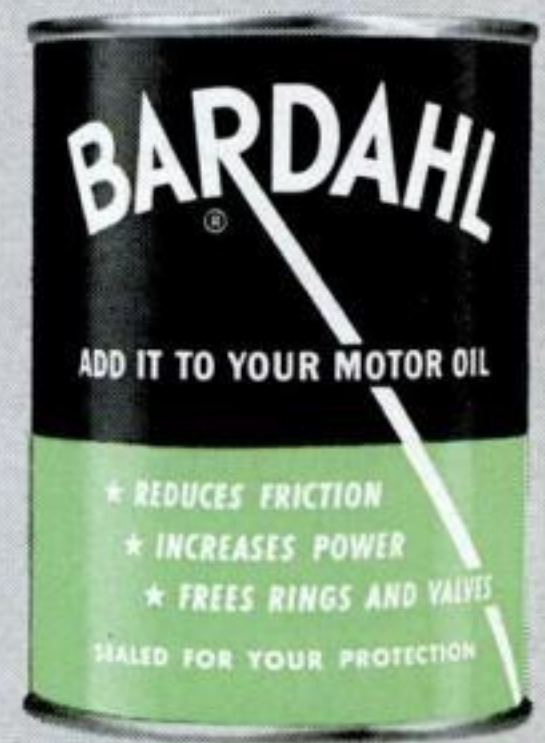
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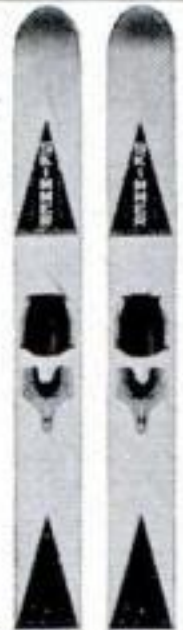
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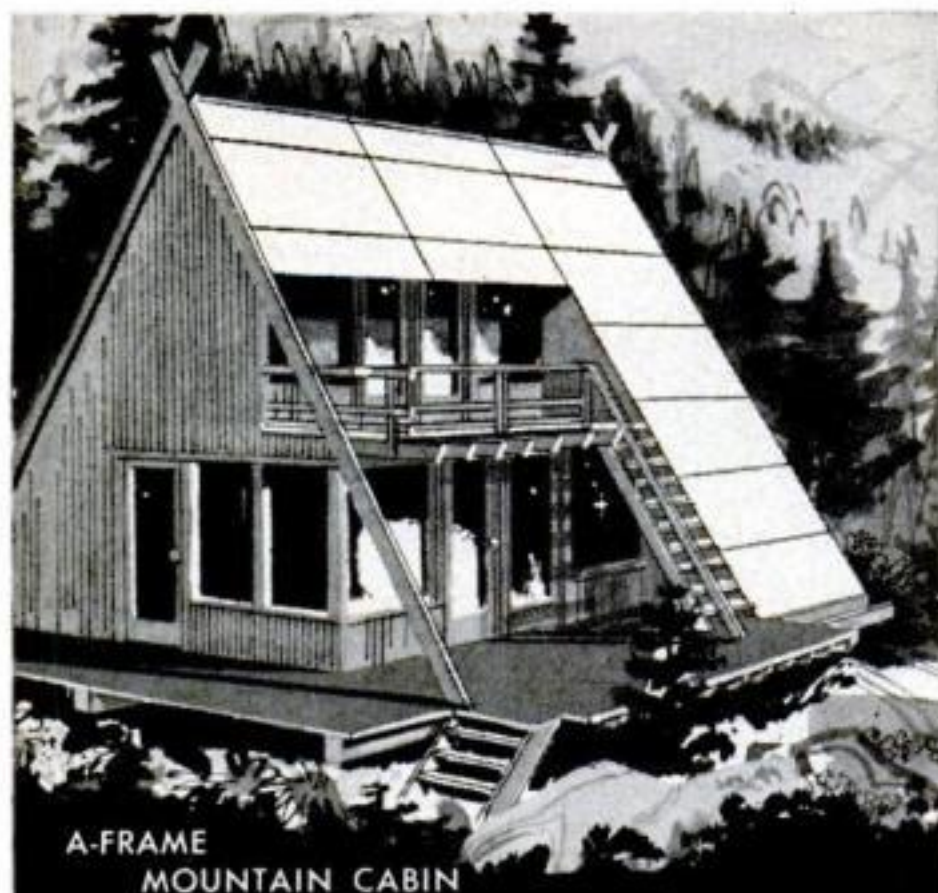
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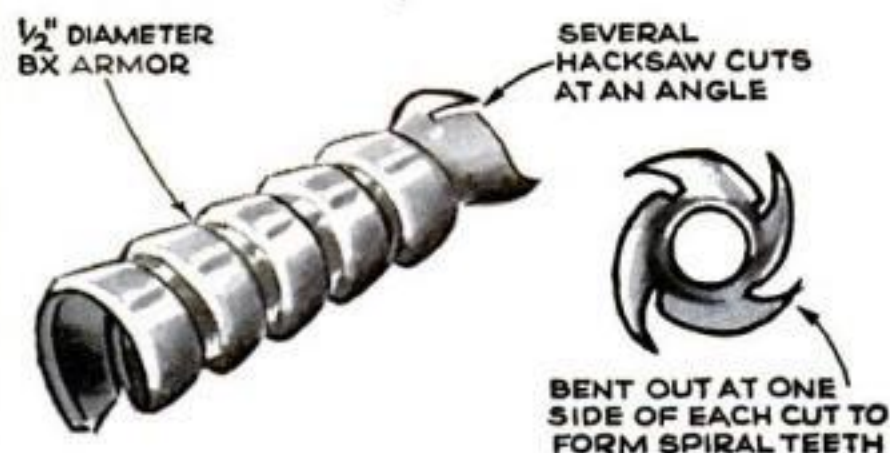
One fine Sunday morning the lavatory bowl in our bathroom refused to drain. We were due at a family wedding that afternoon, had a hundred miles to drive, and my wife and daughter frantically told me they just had to wash their hair.

Still unshaven myself, I cleared the basin drain plug, but water still stood in the bowl. Opening the gooseneck plug, I cleared out sludge there, triumphantly replaced it, and got set to whisk off my whiskers. But the water I ran in to wet my shaving brush didn't run off.

Again I opened the gooseneck plug, then pushed rods, screwdrivers and bent wires in at every angle. On the waste-side pipe of the gooseneck they were stopped by something that wouldn't move.

Getting a two-foot scrap of BX cable from the basement, I pulled the wire out of it and hacksawed a few shallow cuts at an angle in one end. Then I bent the armor outward on one side of each cut, forming spiral teeth.

Pushing this as far as it would go into the gooseneck (it followed the curve), I turned it against the tooth direction. The points caught, held, and I pulled out the clogging mass in one try. For our family, that dodge saved the wedding day.—O. J. Philberry, Cedar Rapids, Iowa.





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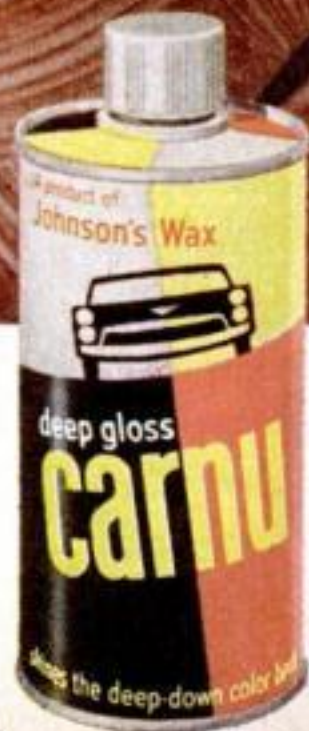


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**POPULAR
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From the labs...

The Car That Drives Itself

The car in your future will be run by black boxes while you watch. Here's a peek at what's coming

By Martin Mann

I DROVE a car no hands. It steered itself safely down the center of the lane, up the straightaway and around a hairpin, automatically following an electronic track.

Sure, the job I rode was experimental—strictly a breadboard rig cobbled into a green Chevy. It automates steering alone, and that only on a one-mile-long GM test road and a 300-foot stretch of Nebraska Highway 2, which are the two places in the world equipped with the

electronic guiding track that is needed.

Yet it is significant because it is one of several steps leading straight to the car that drives itself. And that, a tour of Detroit research palaces convinced me, is definitely coming. Not this year, probably not next, but still soon.

Idea men at Ford, General Motors and Chrysler are noodling over a problem you know well: Broad expressways crisscross the country for high-speed, no-stop trips between cities. Powerful, roomy cars make such travel convenient. But...

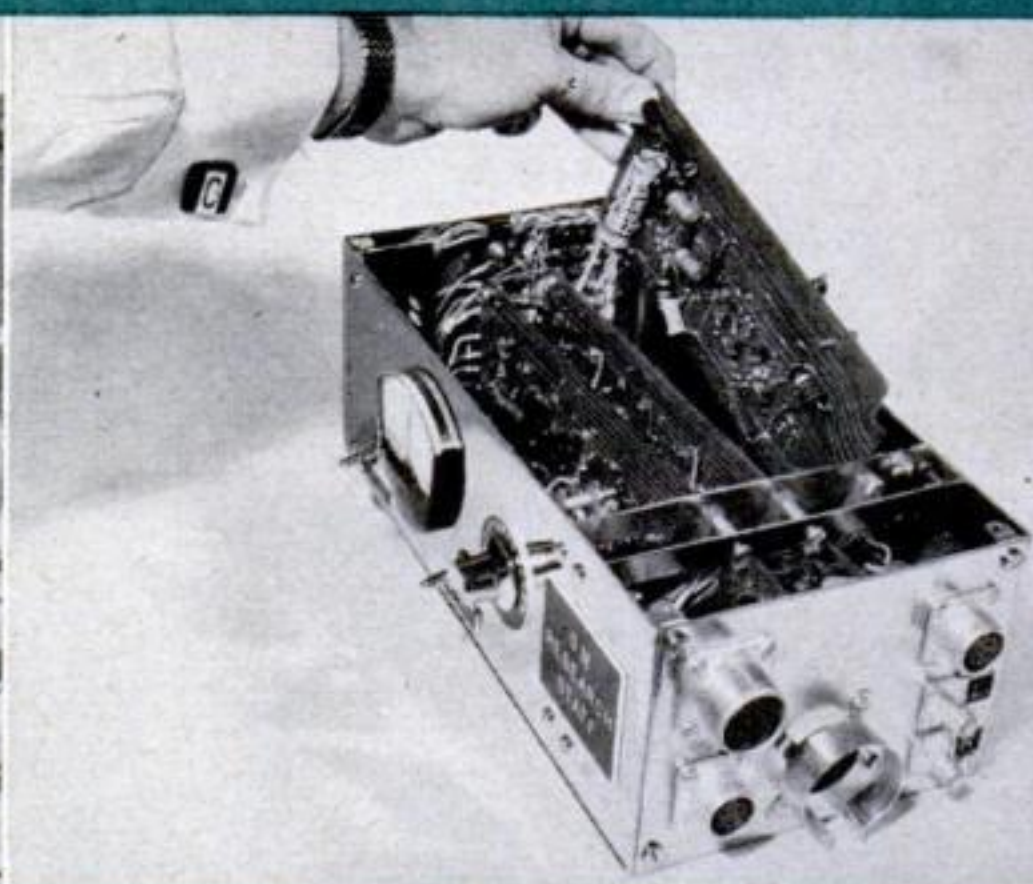
Beguiling roads and cars invite heavy

MAY 1958 75

GM wants to control cars from units built into road



ELECTRONIC TRACK that automatically steers cars is simply cable, laid in $\frac{1}{4}$ -inch saw-cut in concrete and then covered with asphalt. It emits weak radio signals along its length.



GLOVE-BOX COMPUTER is of the analog type, employing voltages to represent car's location on road. Meter on front indicates location visually to permit use for semi-automatic steering.

use. Drivers follow too closely, can too easily get into multi-car collisions. (One pile-up, on the fog-draped New Jersey Turnpike November 15, 1952, involved 16 cars, injured 24 people, killed two.)

Most auto-research engineers agree on the ultimate solution: "a loosely coupled train." Since automobiles have now assumed much of the railroads' inter-city travel function, they will have to operate by railroad principles. This means at least semi-automatic control of path (tracks) and headway (a block system).

Technically, this can be done now. The engineering foundation, if not all the hardware, already exists.

Next question: *How* should it be done? Here, agreement stops.

General Motors has latched onto a scheme originated by Dr. Vladimir Zworykin (the TV-tube inventor) and his assistants at RCA. It uses radio signals from devices in or alongside the road to control the car. The car itself needs little beyond a radio receiver, a mouse-brained electronic computer, and some links to existing power-assist machinery.

Ford's research specialist Victor Raviolo snorts at the idea of putting the works in the road. "I won't live long enough to see the U.S. highway system

rebuilt. Reality deals with something you can add piece by piece."

Chrysler, apparently uncommitted to either approach, takes a dim view of the safety value of any automatic control.

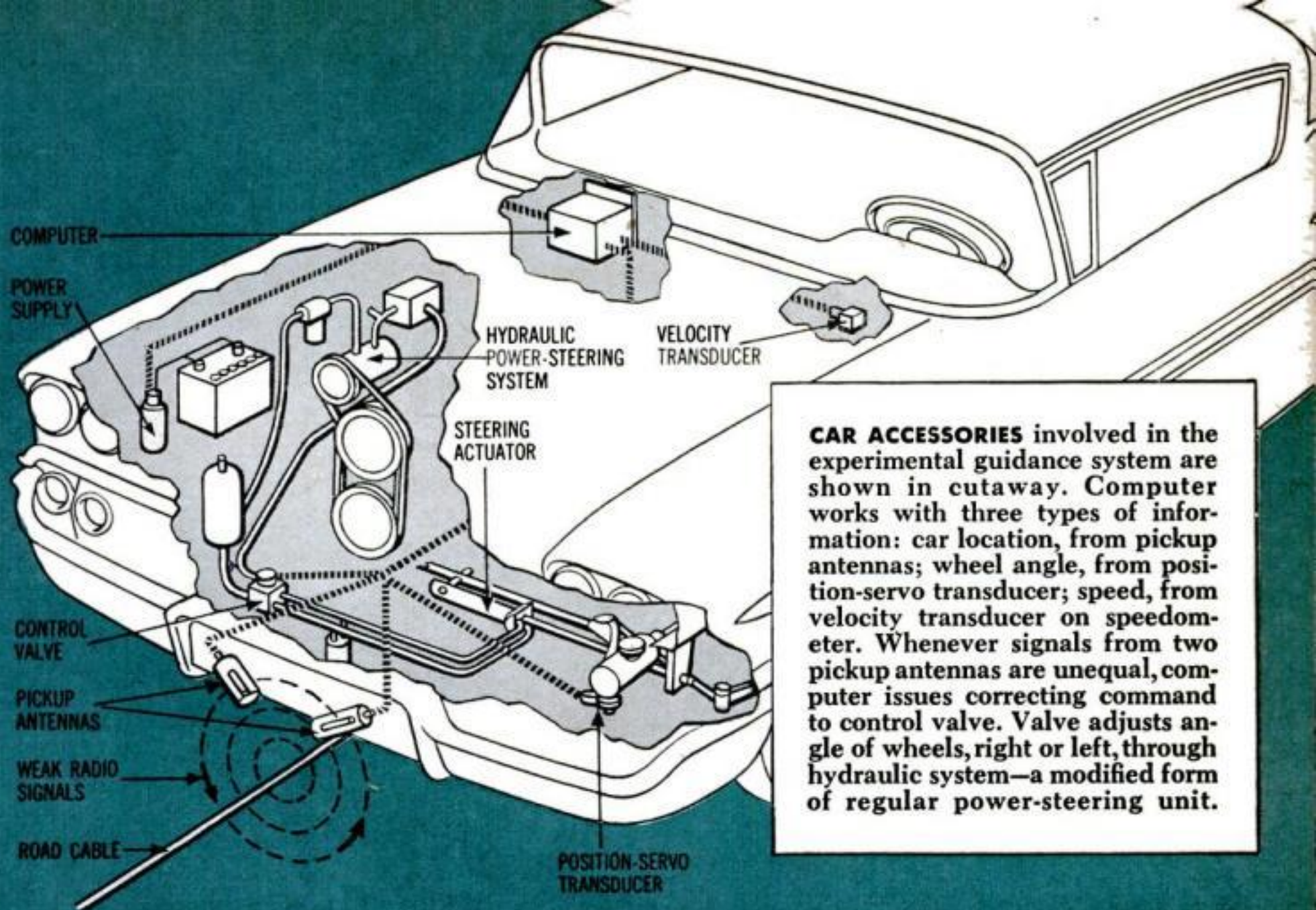
Electronic tracks. The GM-RCA system controls both path and headway through an almost literal electronic translation of railroad practice. Instead of steel tracks there is a cable buried in the center of the highway lane. Instead of block signals, roadside radio transmitters govern accelerator and brakes.

Automatic steering is the simplest to work out. Here is how GM researcher Joseph Bidwell has done it:

The control cable is just a wire buried in the road. A slot for it is cut by running a diamond-wheel saw down the road.

The cable is fed alternating current at a low frequency (below broadcast-radio band) and low power (a couple of watts would take care of 100 miles or more of cable). So the cable is really a radio-transmitting antenna (its range is so short that it is not legally classed as a transmitting station). It generates an electronic track of weak radio waves straight down the middle of the lane.

The car has two receiving antennas: plastic tubes containing ferrite-core coils



and rectifiers. The radio signals picked up by the antennas are rectified to DC (to avoid trouble with capacitance of the wiring) and fed back to a small electronic computer in the glove compartment.

The computer—a couple of printed-circuit boards and 15 vacuum tubes—compares the voltages from the two antennas. If it gets higher voltage from the right-hand antenna, it knows that that antenna is closer to the cable than the left one and the car must be sidling to the left. So the computer signals an electro-hydraulic servomotor under the hood to make the power-steering mechanism turn the wheels to the right. When the computer gets equal voltages from both antennas, it knows the car is straddling the cable, and it holds the steering machinery steady.

The system works quite well. It's eerie. The car follows the road, the steering wheel turns, all without human interference. Still, there are bugs:

The control hunts, that is, overcorrects first one way then the other. This despite the fact that the computer calculates the rate of change of voltage from each antenna and bases its decisions on variations in rates rather than on variations in the voltages themselves.

Some unexpected wiggles—particularly noticeable in the back seat—were caused by misalignment of the track. It was laid with the edge of the road as a guide, and that was apparently not true enough.

These faults are easy to fix. The real trouble is that automatic steering is not much good without automatic speed control. And that's tougher.

You need two types of control: 1) a maximum speed, adjustable for weather and curves, and 2) collision prevention.

Again, low-power radio signals would do it. For the first task, small transmitters placed along the road—where speed signs are now—would adjust the upper limit on an accessory like Chrysler's Auto-Pilot. Highway officials would set each transmitter to send out a speed signal safe for the stretch of road it covered—essentially what they do now with signs.

Collision prevention. Dr. Zworykin's idea, already tried in Nebraska, involves current-carrying loops of wire buried in the pavement. Passage of the steel in a car over the loop changes the electrical inductance of the loop, varying the current. Computers at the side of the road, detecting this current variation as the car passes over successive loops, flash warn-

Ford's plan to help the driver: accessories on the

ing signals along the road behind the car. The signals are transmitted by the same radio units that send speed maximums.

In effect, the car triggers block signals as it moves down the road. In the block immediately behind it is a powerful crash-stop command, in the next distant block a medium hit-the-brakes order, in the most distant block a weak ease-up warning.

The receiver on a following car picks up the warning signal and feeds it to the car's computer. From the strength of the signal, the computer deduces what car speed should be to prevent collision. If actual car speed is higher, it does things with brakes and accelerator.

GM, hoping to eliminate the detector loops, is now soldering up a new, still-secret system for collision prevention.

As far as the car is concerned, these computers and radio receivers should add to its cost about as much as an automatic transmission. But the highway has to be studded with electronic gear. The expense, \$5,000 or \$10,000 per mile, is peanuts compared to the cost of the highway itself (upwards of \$1,000,000 a mile), though it does add up. The real problem is time: It takes quite a while to get all highway officials to agree on a new idea, far longer to get them to put it into countrywide use.

GM's Bidwell expects an elementary version of this system in a usable length of highway within a year or so. It would be added to gradually. On the opposite side of the fence, Ford's Raviolo thinks it would take a century to equip all U.S. highways. That's why he dismisses control from the road as impractical now (but agrees that some roadside elements will eventually be necessary).

Control from the car. Raviolo settles for limited objectives. He is not aiming yet to make a car that drives itself, but simply to provide the human driver with more and better information.

Still, he is willing to try this the hard way—with equipment on the car, accessories that you buy. And he is tackling a difficult and pressing problem: collisions—more specifically, rear-end crashes.

Even here simple gimmicks can help a lot. Raviolo cites a few off the top of his head:

Expert motorists drive by the guy

ahead. So stop signals readable at greater distances would be an easy and useful improvement. (The Christmas-tree-drape fins on recent models are one step.) But why not put tail lights on a mast atop the car? Then, in a line of cars you could spot a stop signal many cars ahead.

Yellow slow-down lights, to warn following drivers to think about getting ready to stop, might also be worth while. (A few years back a popular accessory was a miniature traffic signal hung in the rear window. It showed green, yellow or red, depending on whether the car was going steady, slowing or stopping. It was illegal in many states—the law frowns on green or yellow lights to the rear.)

Why radar doesn't work. Anything beyond simple light signals gets very tough indeed. A black box that automatically tells you when you are too close to another car—a proximity-warning device in engineering lingo—has to sense the presence of an obstacle, calculate the rate of closure with it, then light the danger sign when necessary. It must work day or night in any weather. And it must never make a mistake, neither missing real danger nor crying emergency when there is none.

There are five or six ways to make a prox warner. And there's something wrong with every one:

Radar. Even assuming size and cost could be licked (a police speed-radar set comes to \$900), an insurmountable fault remains: discrimination. Radar "sees" any solid object. At a curve, it would mistake cars in opposing lanes, or an embankment or trees off the road, for collision-course obstacles.

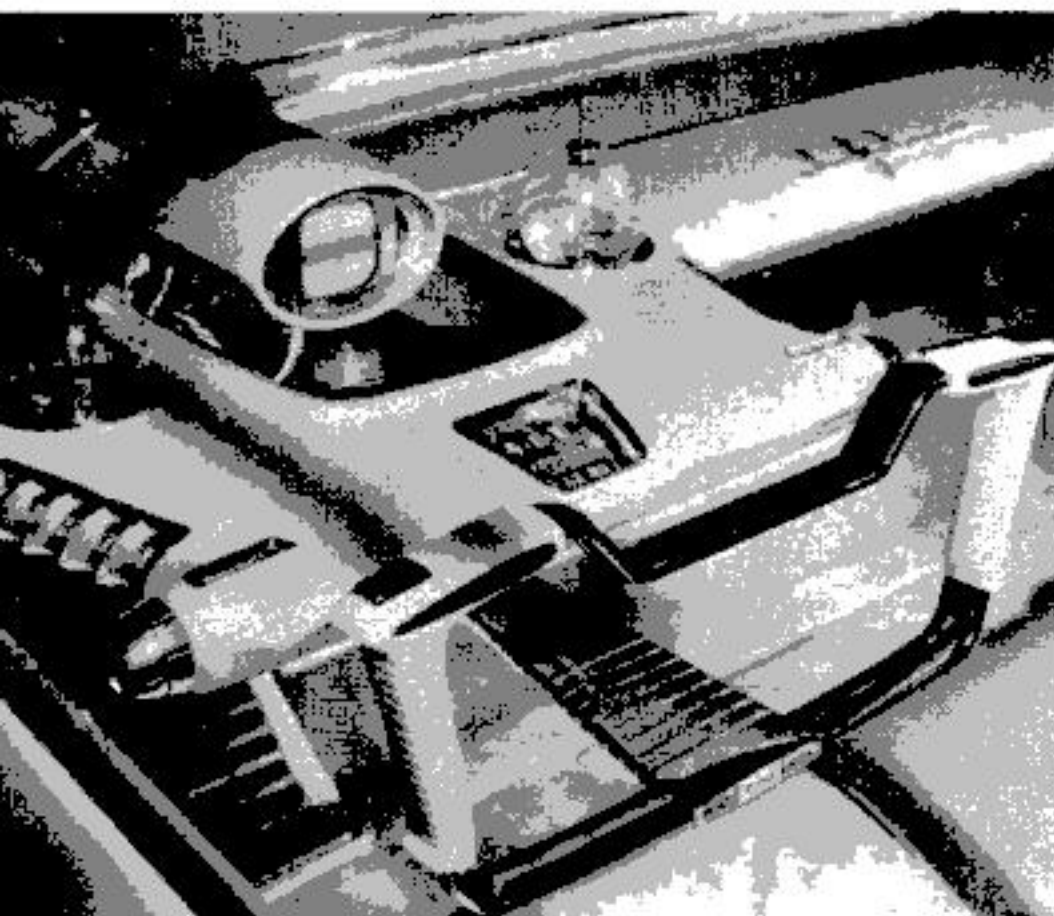
Radio beacon. A small transmitter broadcasting a weak signal around the car, to be picked up by receivers in approaching cars (like IFF in military airplanes), would work. But only if every car, truck and bus on the road were equipped. This defect is fatal; it has helped stop another good auto idea: polarized headlights.

Infrared. Cars give off heat, all right. The difficulty here is in making detectors that are sensitive enough and able to measure range.

Light beams. No good in bad weather.

Sound. Air, unlike water, is such a

car. Coming first: an automatic collision warning



WILL IT LOOK LIKE THIS? "Proximity warning screen" (oval between two glass balls) is on dash of the current Ford dream car, La Galaxie. It's just a styling mock-up, without works.

poor conductor of sound that a sonarlike ranging system seems out. The sound beams wouldn't probe far enough away from the car.

Despite this bleak outlook, Ford is playing around with prox warners. I saw one, an operating model built to show off at a board of directors' meeting.

It was a laboratory-bench stretch of model railroad, with two locomotives representing cars. Engine No. 1 carried a pair of headlights. Engine No. 2 had a photoelectric cell pointing at Engine No. 1. The photocell was connected to a simple computer able to figure the rate of increase of light intensity.

As Engine No. 1 overtook No. 2, the computer kept tab on their separation through the light change, finally blinked a warning lamp.

This scheme is not much good (it won't work in daylight or fog) and Ford has abandoned it. Another type of prox warner is in the mill. What kind, Ford won't say. It could involve radio induction (the RCA-GM concept moved off the road into the car) or infrared (great strides in military equipment are just now being declassified).

But this much is certain: It will be small, entirely car-borne and no more expensive than a radio.



MAST FOR TAIL LIGHTS is simple device that Ford suggests to reduce rear-end smashes—drivers could watch stop lights many cars ahead. Yellow "slow-down light" could also help here.

Don't forget the old radio. One piece of "safety equipment" already installed in nine out of 10 U.S. autos is the radio. Today it is as much an aid to driving as a source of entertainment.

The commuter who navigates by radio is a commonplace. Before he backs out of the garage, the loudspeaker is feeding him admonitions, advice and police flashes: "Take it easy, fog on the parkway," "Jackknifed truck has tied up route such-and-such," "Bridge traffic heavy but moving," and so on and on day and night.

Highway people have encouraged this idea, but the big push came from the radio broadcasters themselves. Having lost their big home audience to TV, they found they could make money by providing a public service to the TV-less motorists. Now the auto experts are hot to expand and improve radio-driving. Some attempts have been made. For instance:

- New York City's Lincoln Tunnel for several years broadcast bulletins over its own private radio station, audible only within the tunnel.

- The New Jersey Turnpike considered building a transmitter of its own so that it could talk to motorists, but has shelved the idea. (Reason: cost.)

- Los Angeles radio (and TV) stations

[Continued on page 226]

Preview of Polaris:

Quick-Trigger Missile to Rise from

By Wesley S. Griswold

ONE long-range U. S. ballistic missile in the works already seems too good to be true, though it is still some months away from test-firing. That's the Navy's onrushing Polaris, named for the North Star, which can be launched from a submerged submarine to hit a target 1,500 miles away.

Polaris, two years ahead of schedule now and "closing fast," as the admirals say, is due to be flight-tested this fall and operational by 1960. It gives promise of making its big brothers—Atlas, Titan, Jupiter and Thor—seem clumsy, over-complicated and too conspicuous.

Those other long-range missiles have to be fired from large, fixed bases—immovable targets for enemy counterweapons. The missiles themselves are huge, vulnerable to saboteurs, immensely complex (Atlas is said to have 300,000 parts) and exasperatingly slow to prepare for firing. Their fuel is highly inflammable and the liquid oxygen they use as an oxidizer has a temperature of minus 275 degrees F., so that it boils away constantly and threatens to freeze missile parts.

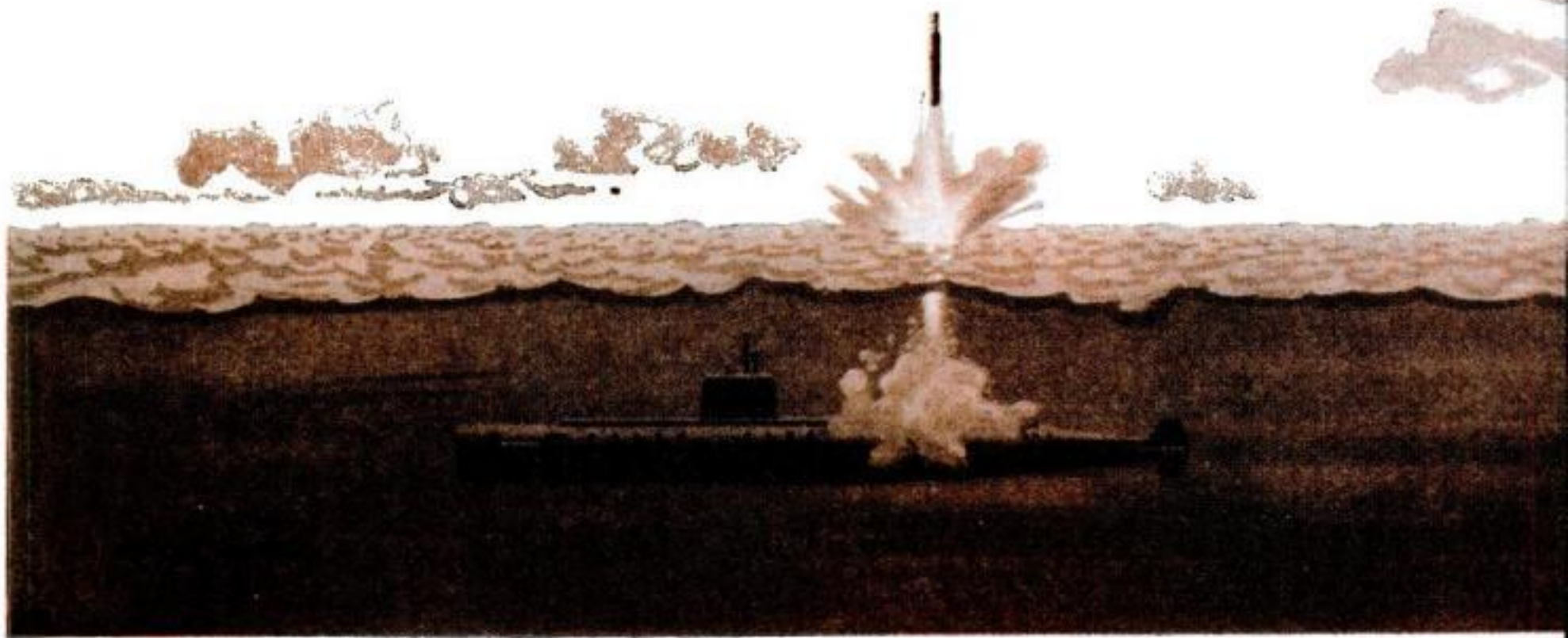
Polaris, on the other hand, given a fleet of nuclear-powered submarines to

carry it through the seas of the world and lie in hiding with it off foreign coasts, for months if necessary, will have two decisive advantages: secrecy and mobility. It will be much smaller and simpler than the land-based ballistic missiles now being tested. And, unlike them, it will be as ready to fire as a rifle cartridge, for Polaris uses solid fuel, which can be stored safely and indefinitely.

Since there is hardly any place on earth that is more than 1,500 miles from ocean waters, the world's military targets will all lie within reach of Polaris. It shapes up as the most arresting deterrent weapon so far, for it will threaten a potential attacker with retaliation within minutes, from unknown directions and hidden locations.

"The enemy would be in the position of a man trying to find a black cat on a vast and empty plain on a moonless and starless night," said Rear Adm. H. G. Rickover. Long-range missiles hurled upon an aggressor from an "underwater satellite" such as this "would draw the enemy's missiles and bombs away from our cities and factories and farms and toward the uninhabited seas," the admiral predicted.

Even one submarine carrying a capacity load of 16 Polaris missiles will pose



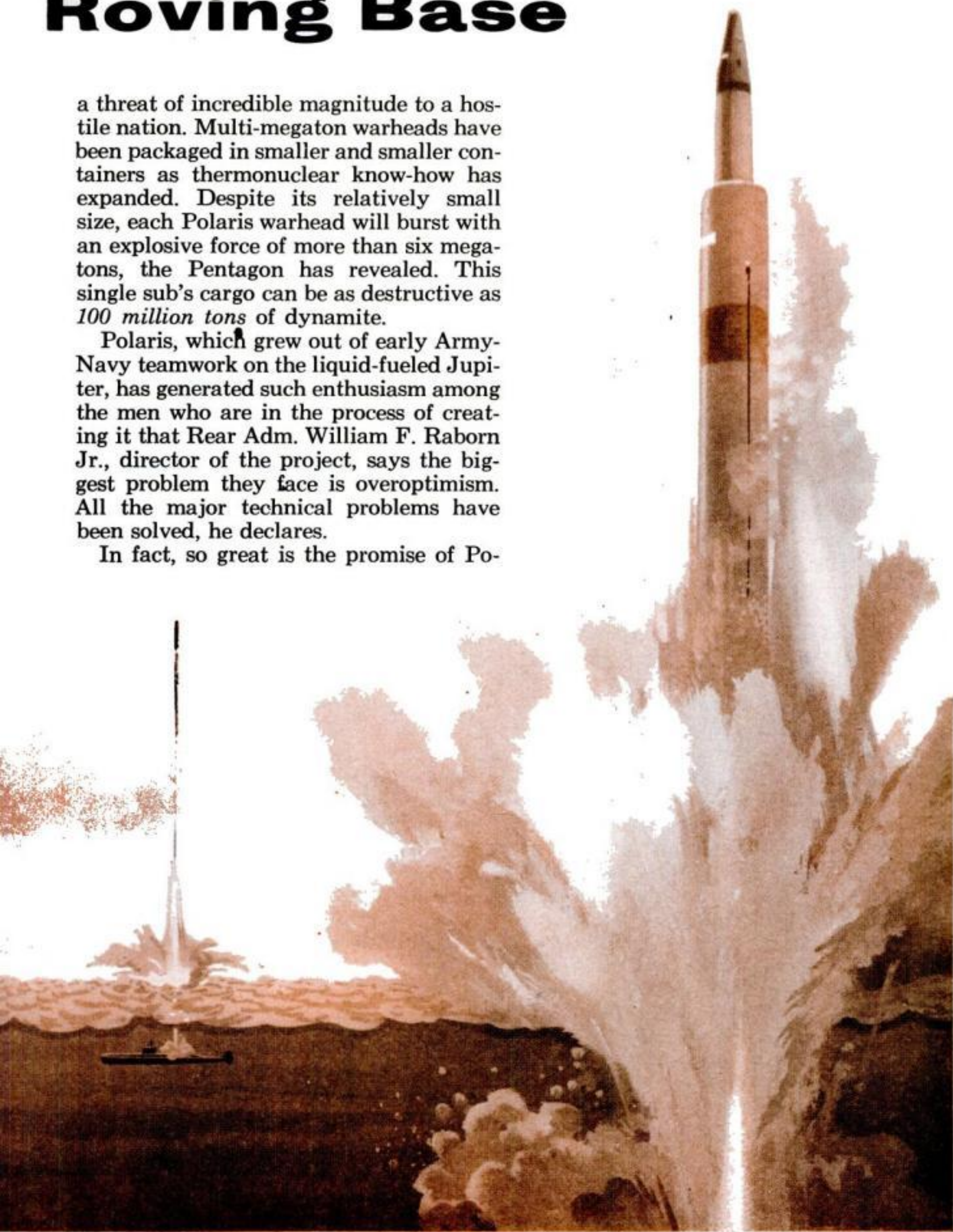
**Launched from ocean depths by wide-ranging nuclear subs,
Polaris will threaten the enemy with instant retaliation**

Roving Base

a threat of incredible magnitude to a hostile nation. Multi-megaton warheads have been packaged in smaller and smaller containers as thermonuclear know-how has expanded. Despite its relatively small size, each Polaris warhead will burst with an explosive force of more than six megatons, the Pentagon has revealed. This single sub's cargo can be as destructive as *100 million tons* of dynamite.

Polaris, which grew out of early Army-Navy teamwork on the liquid-fueled Jupiter, has generated such enthusiasm among the men who are in the process of creating it that Rear Adm. William F. Raborn Jr., director of the project, says the biggest problem they face is overoptimism. All the major technical problems have been solved, he declares.

In fact, so great is the promise of Po-



"Scientists' eyes light up when they see Polaris the way sailors' eyes do when they look at Marilyn Monroe"

laris that the Defense Dept. recently announced that it will be fired from land bases as well as from beneath the sea.

"This is a more sophisticated missile than Jupiter," Adm. Raborn says. "It's a sexy little devil. Scientists' eyes light up when they see Polaris the way sailors' eyes do when they look at Marilyn Monroe."

In modern military lingo, the word "sophisticated" implies improved accuracy and efficiency. And Polaris, one-third as big as Jupiter and Thor, is "little" only as IRBMs go. It is to be about 30 feet long, five feet in diameter and will weigh around 30,000 pounds, says Rear Adm. John E. Clark, chief of the Navy's Guided Missile Division.

How can 16 missiles of this size be packed away in one submarine? The nuclear-powered subs that will carry and launch Polaris will be the biggest in the Navy and, so far as we know, in the world. They will be 380 feet long and 33 feet wide. Each will have a displacement of 5,600 tons. The first three of these giant submersibles, which will be whale-shaped like our experimental submarine Albacore, the Navy's fastest, have already been ordered. They will be ready by the time the missile is, Adm. Raborn predicts.

Polaris will be launched from the ocean depths much as a torpedo is fired. It will be shot to the surface by compressed air, and its rocket motors will ignite as the missile breaks clear of the sea. The firing crew will know exactly how many seconds it will take the missile to reach the surface and will set a "programmer" inside the weapon to touch off its motors when it leaps out of the water.

Each of the great subs being built for Polaris will carry 16 vertical tubes. The missiles will be fired straight up instead of from bow and stern tubes like torpedoes. This will make it easier for each missile's flight controls to steady it, first in the rolling sea and then in the air, as it roars upward on a trajectory that will rise 350 to 400 miles above the earth and span 1,500 miles.

Polaris is often called a "second-generation" missile, because it benefits from the trials and errors of the much cruder

missiles that grew up before it. For example, Polaris' inertial-guidance system is "the finest and smallest missile-guidance system yet developed," says Adm. Raborn. A "bundle of tiny gyros and integration accelerometers," it cannot be jammed by enemy radio or radar.

The Navy IRBM could carry either batteries or a midget generator to spark its mighty motors and supply current for its guidance system. The final choice may well be a gas-powered generator, about the size of a can of soup, that GE has already built. This marvelous mite converts liquid hydrogen peroxide into a high-pressure stream of gas that can drive a turbine.

The most important event in Polaris' young life, however, was a recent breakthrough in solid-fuel technology, achieved by Aerojet-General Corp.

In firing a long-range ballistic missile, it is essential to cut off its motive power at that precise point where speed, altitude and heading are just right to let it fall from there to its target. If this cut-off point is either premature or delayed, the missile will miss its mark. For years it has been thought that such precision could be achieved only by liquid-fuel motors, in which valves can instantly be closed. There seemed to be no feasible way to shut off a solid-fuel motor so abruptly.

Furthermore, liquid fuels had a decided edge on solid fuels in specific impulse—the amount of thrust derived from a given weight of fuel per second of burning. Liquid fuels, as one missile engineer put it, just had "more poop per pound."

Then, within the past year, Aerojet crashed through with ways to overcome both these handicaps to the use of solid-fuel motors in Polaris. (It was known from the start that it would be unthinkable to try to launch a liquid-fuel missile from a submerged submarine.)

Details of Aerojet's achievements are largely secret, but Navy brass have declared that Polaris can be smaller, simpler and more reliable because of them. Outsiders have guessed that cut-off may be achieved by some thrust-reversal mechanism, or simply by the timed destruc-



POWERFUL SOLID-FUEL ROCKET MOTOR, the type used in Polaris, is tested at Aerojet's plant near

Sacramento, Cal. Unlike hard-to-handle liquid-fuel rocket, this one is always ready.

tion of part of the rocket motor or casing.

Not only can the solid fuel's burning time now be exactly limited, but its specific impulse has been given a sharp boost. It is a high-energy propellant, according to Adm. Raborn, who describes it as a "light-to-dark-gray odorless powder, safe to handle." Since Aerojet has been doing research with boron compounds since the early 1940s and recently formed a partnership with Stauffer Chemical to develop and produce them, it may have been boron that put new fire in Polaris' fuel.

Fuel improvements made it possible for Aerojet to produce a much lighter, more streamlined power plant for Polaris than had been anticipated, but it is still the largest ever made for a specific missile using solid fuel. It has been estimated that Polaris' motors will deliver around 130,000 pounds of thrust for somewhat longer than half a minute.

Polaris' skin will be stainless steel or aluminum alloy, Adm. Clark has said. Its snub nose, so shaped to deflect most of the intense heat generated when it plunges back into the earth's atmosphere at 9,000 m.p.h., will be covered by protective layers of plastic, copper, or possibly beryllium.

Before Polaris is ever fired from the ocean depths, it will be trial-launched from surface vessels at sea. But before that, it will be given an intensive workout on as strange a test apparatus as has ever

been built. It is a huge device, created by Loewy-Hydropress, that exactly simulates the pitch, roll and heave of a ship at sea. Magnetic-tape recordings already made of the motions of a vessel on the ocean will be fed into this monster machine, set in a hole 75 feet deep at Cape Canaveral, Fla., and the machine, with gimbals and enormous hydraulic pistons, will reproduce every motion exactly. The apparatus will be able to test-launch Polaris, too.

But this amazing missile would be useless if there had not been a development in navigation to match those in missile technology. By conventional methods, no point in the ocean beyond sight of land could be located precisely enough to serve as a launching spot for an IRBM. The missile's guidance system must know *exactly* where it is before launching in order to measure the distance accurately to where it is supposed to go.

That problem has been solved by security-cloaked SINS (Ship's Inertial Navigational System), devised by Dr. Charles S. Draper of M.I.T. and built by Sperry Gyroscope. This inertial-guidance system will keep Polaris-carrying subs continually informed of their position, the location of true north and the craft's speed. SINS, which has been tested in a year of voyages by a special vessel called the Compass Island, can give the geographical coordinates of a spot beneath the waves as precisely as if it were a street corner in your home town. **END**

NEXT MONTH: *The first nation to control the weather will wield a power greater than the H-bomb. Read "Weather as a Weapon"—in PS for June*

SPUTNIK I'S CARRIER ROCKET (arrow) is tracked by radar with movable 250-foot-wide bowl of huge English radio telescope (opposite page). Rocket's tumbling motion gave intermittently bright streak in three-second-exposure photo made for Air Force by Arthur D. Little, Inc.



Messages from outer space: **What We're Learning from the Satellites**

U. S. and Russian "moons" bare secrets of space to cameras, radio, amateurs' telescopes

By Alden P. Armagnac

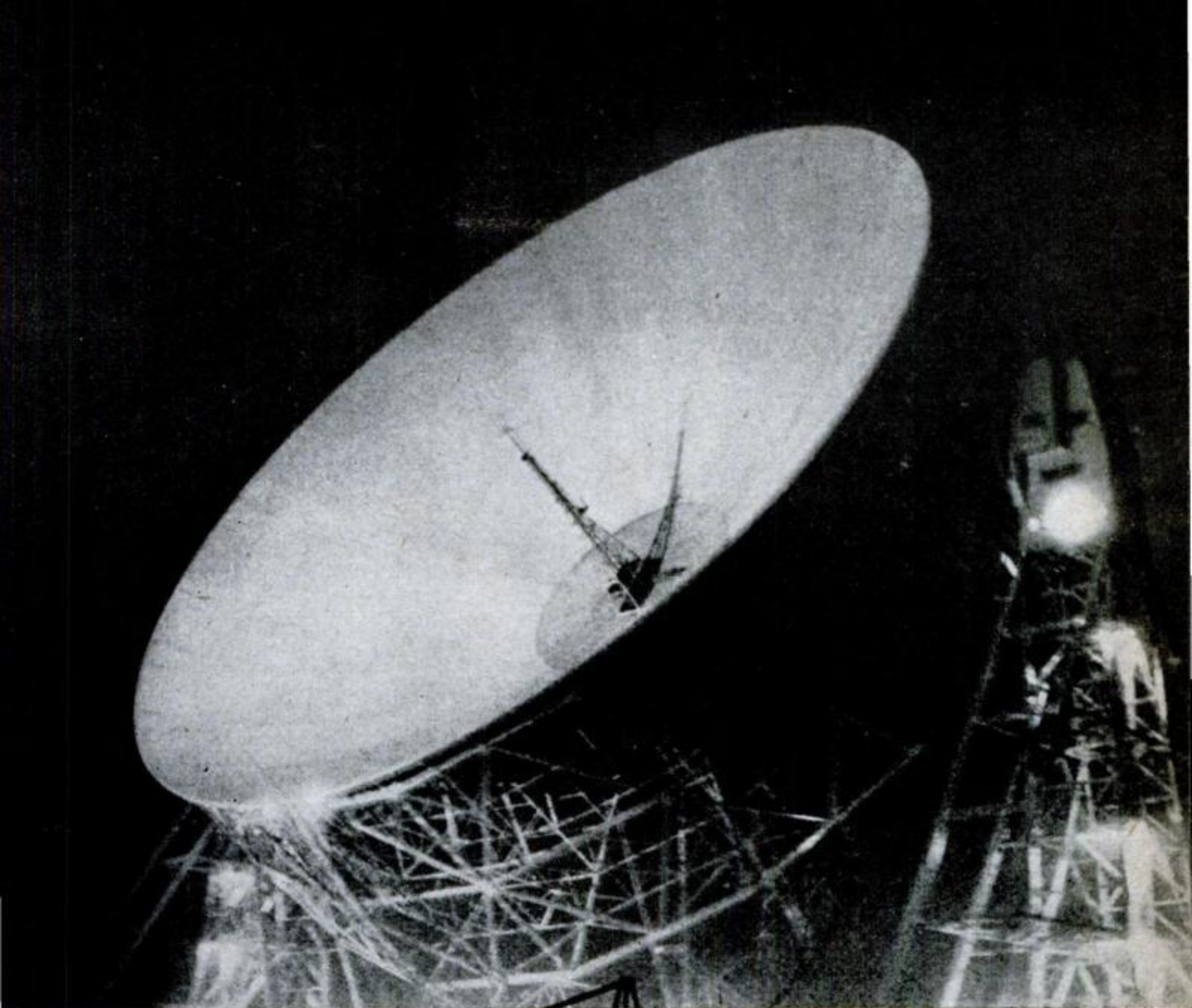
THE satellites are paying off. From a region of mystery beginning 100 miles above the earth, the Space Age's new frontier and the gateway to the moon and planets and stars, U. S. and Russian artificial moons have been wrestling the secrets we must know before man himself braves its perils. And the information being gleaned from our first Explorer and Vanguard satellites and from Russia's Sputniks is proving packed with surprises, riddles and invaluable hard facts about space.

Twenty-five miles of magnetic tape, 11 inches wide, arrived one day last Feb-

ruary at Caltech's Jet Propulsion Laboratory in Pasadena. By oxcart and by plane, it had come from faraway Nigeria, Singapore, and other spots as remote. That was a typical day's news from bullet-shaped, 80-inch-long Explorer I as it wheeled around the earth on the initial rounds of its majestic 115-minute elliptical orbit, dipping to 219-mile altitude and zooming to nearly 1,600 miles.

Within its instrument-containing nose—a dark steel shell striped with white bands, to control solar heating—two radio transmitters prattled away as incessantly as a news commentator. In a code made public so all the world could listen and understand—musical tones forming dissonant chords until later unscrambled—the rapid-fire signals told of temperatures, cosmic rays, and meteors in space.

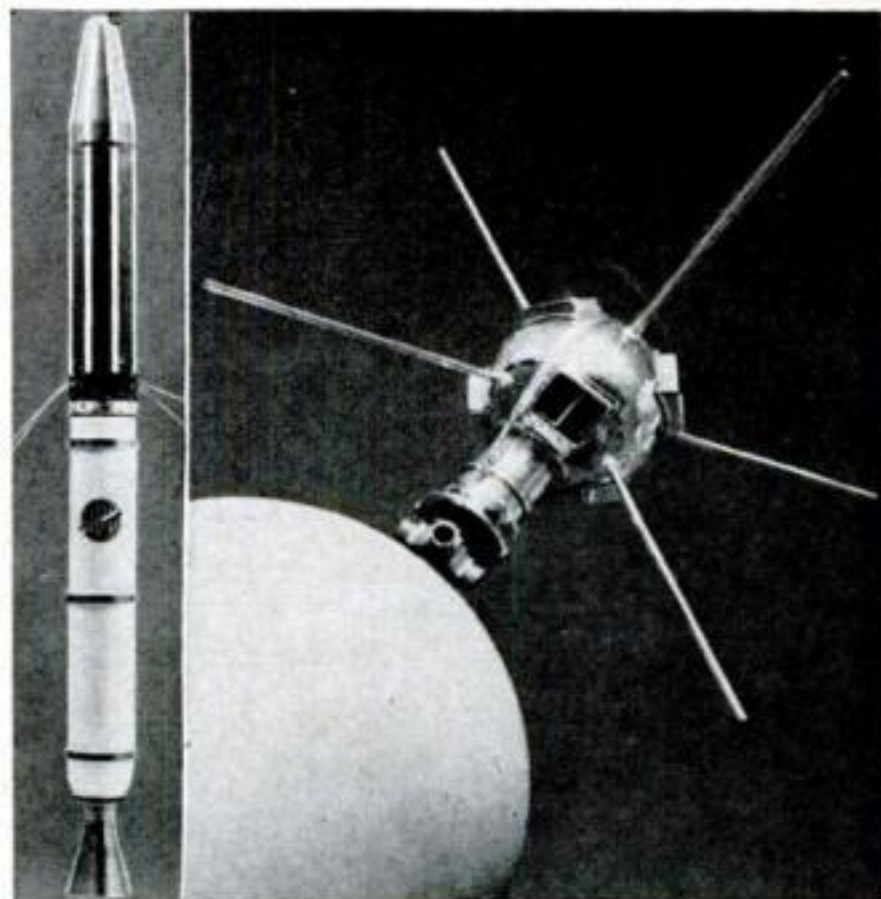
Some messages went unheard and were lost. But for periods of about five minutes



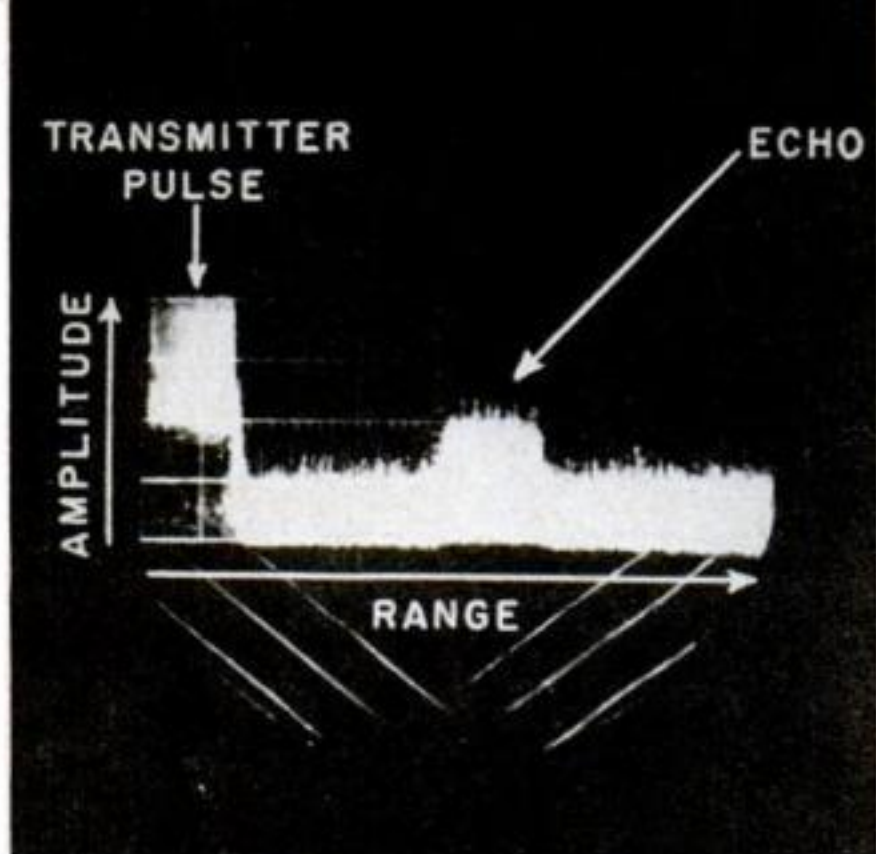
apiece—whenever Explorer I swooped within range of “Minitrack” and “Micro-lock” receiving stations all over the world—the precious messages were caught and preserved on tape. Thence they went to JPL; there duplicate tapes were made and forwarded to the State University of Iowa and to the Air Force Cambridge Research Center, the others participating in the experiments.

Hazards awaiting the first space traveler, it now appears, will be less formidable than many have supposed. That’s the gist of a sampling of Explorer I’s early messages:

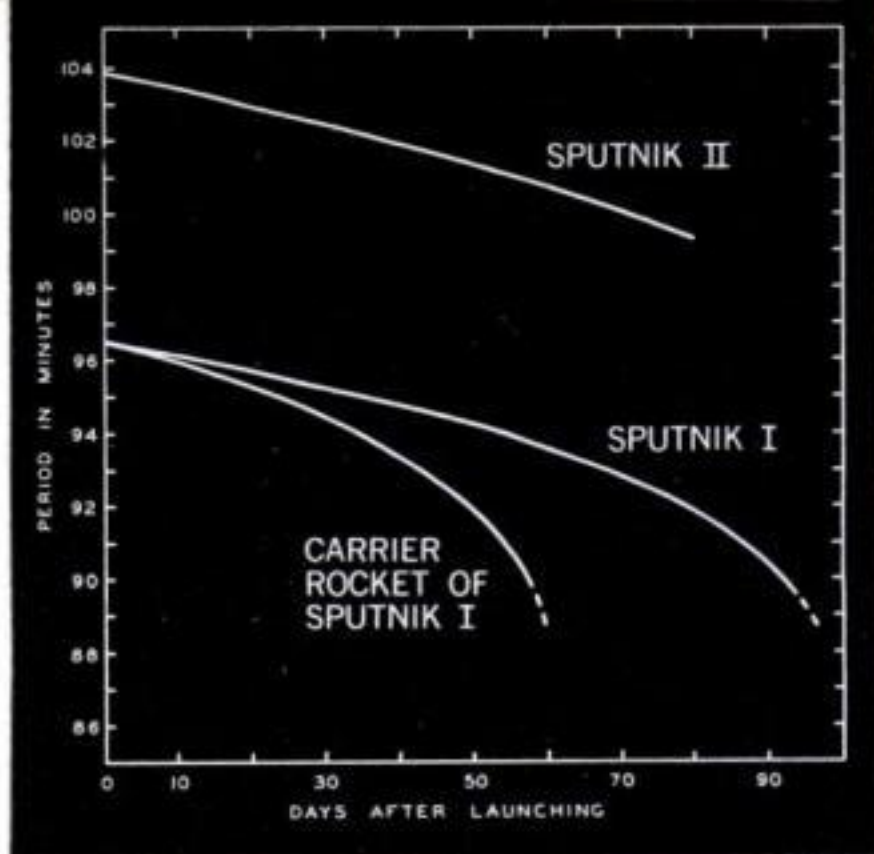
Temperatures: 32 to 149 degrees F. . . . That’s Explorer’s outer skin temperature, reported by beadlike thermistors and resistance thermometers; it’s ranging much less widely than expected, as the satellite whirls from shadow to sunlight . . . *40 to 104 degrees F. . . .* Inside Explorer’s in-



FIRST U. S. MOONS are 80-inch Explorer, left; and 6.4-inch Vanguard sphere—forerunner of fully instrumented Vanguard 20-inchers—shown on nose of rocket that becomes a satellite, too.



RADAR ECHO from Sputnik I rocket was obtained by powerful M.I.T. transmitter at Westmore, Mass. Echo's position, along line marked "Range," shows rocket nearly 600 miles away.



PERIOD (time to circle earth) drops with altitude. At $87\frac{1}{2}$ minutes, end is near; 84-minute orbit would graze earth, but moon burns up first. (Chart from *Sky and Telescope*.)

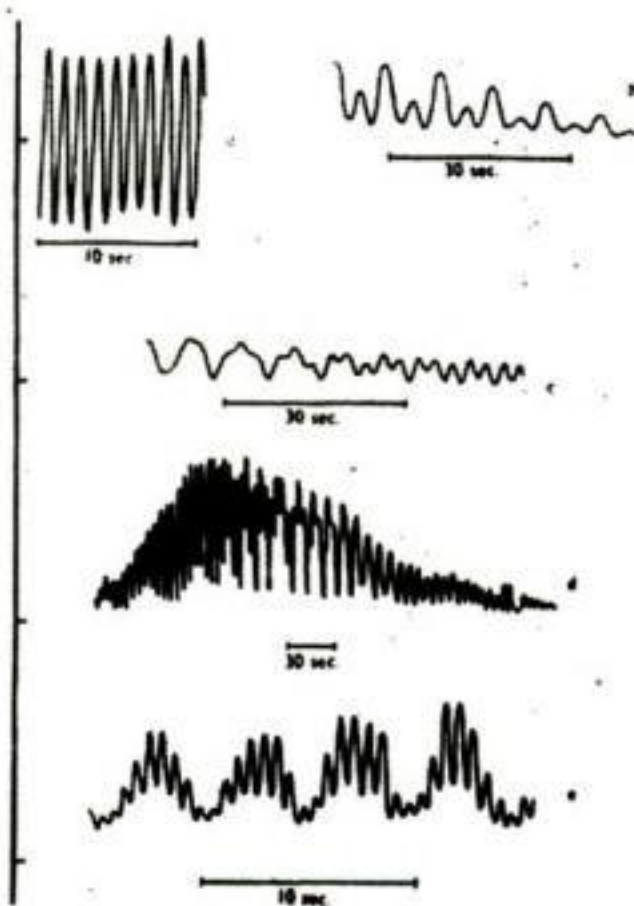
ulated shell, everything is cozy for batteries and transistors. (And not too far from livable temperatures for humans, when they get to riding in space cabins; probably that upper figure can be lowered a bit.)

Cosmic-ray count: 29 . . . 31 . . . 41 . . . That's from a Geiger counter aboard Explorer, as heard in Nigeria, southern California, Florida. High, but not dangerous, as it was feared the penetrating rays might be, up above the earth's protective atmosphere.

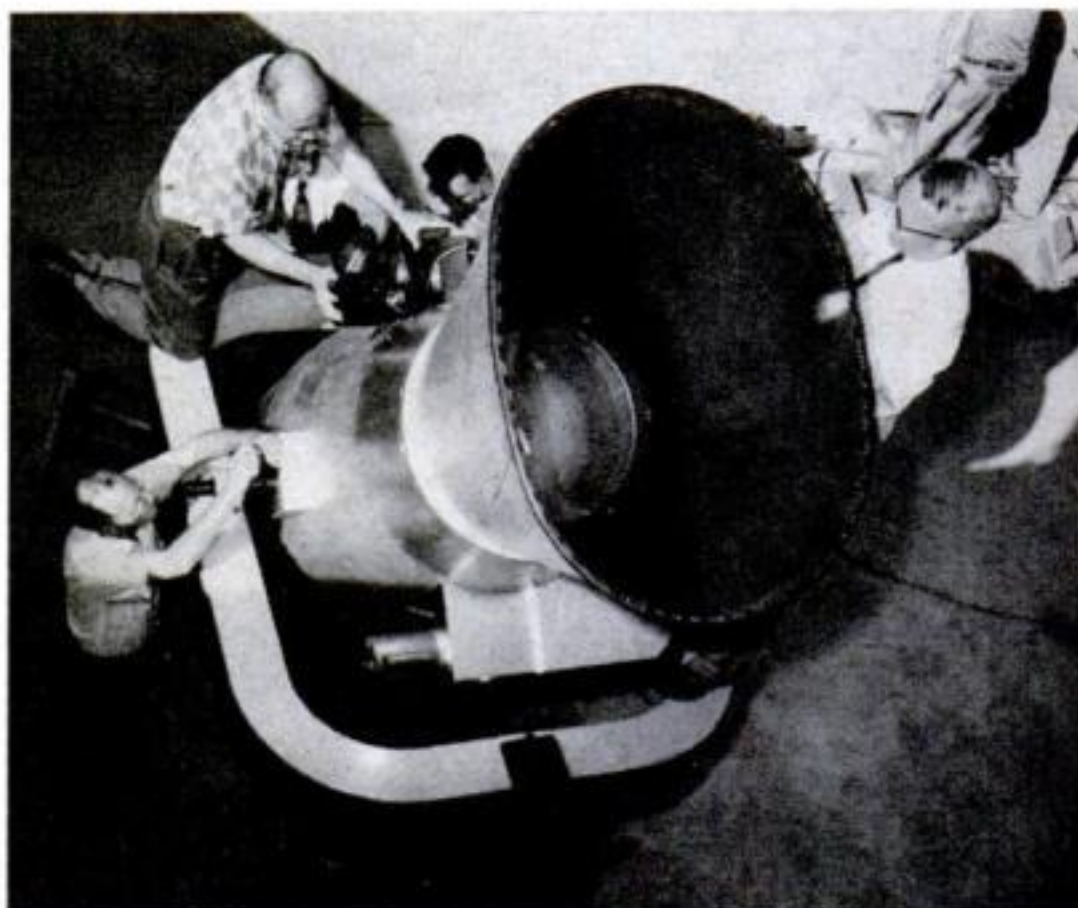
Meteors: .01 particle per square meter per second, 10 microns or larger . . . In scientific language, that's the story of an

"erosion gauge," with one of its 12 fine wires severed by a meteoric particle within the first nine days—and of an "impact microphone," recording the ping of other particles that hit the satellite shell. In layman's language it means that bombardment by meteors, of dust size and up, shouldn't be so much of a hazard as to prevent space travel.

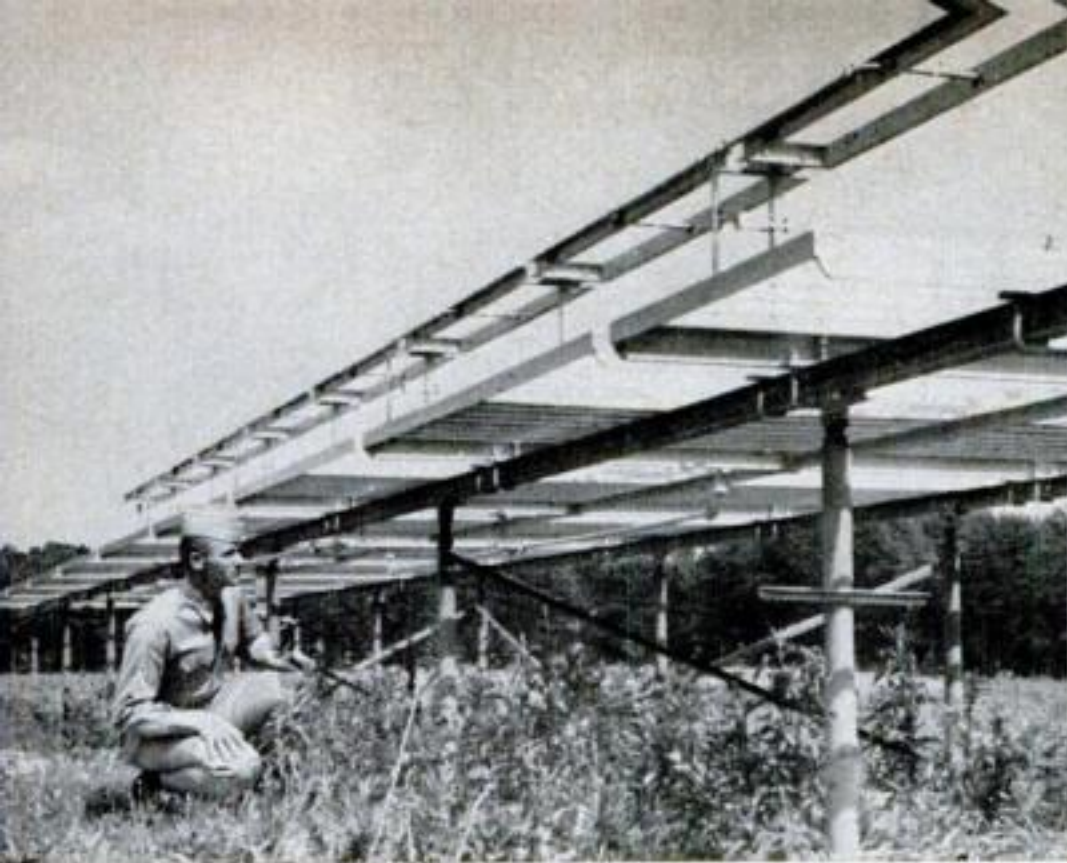
Later U. S. moons introduce refinements. The second Explorer put into orbit had a tape recorder, designed by State University of Iowa scientists to register all cosmic-ray readings—so that none would be lost—and read them out on radio command from a ground sta-



SQUIGGLES show many varieties of fading of radio signals from Sputnik I. They'll aid studies of ionosphere. (Charts from *Nature*.)



GIANT CAMERA photographs satellite against background of stars, for highest-precision tracking. Here is the first picture it caught of Sput-



MINITRACK STATION at Blossom Point, Md., uses great horizontal antennas like one above to pick up radio signals from U.S. satellite wheeling overhead. Receivers automatically



yield direction-finding data, on charts unreeling from bottom of panels in view at right. Other equipment makes tape recording of instrument readings transmitted by satellite.

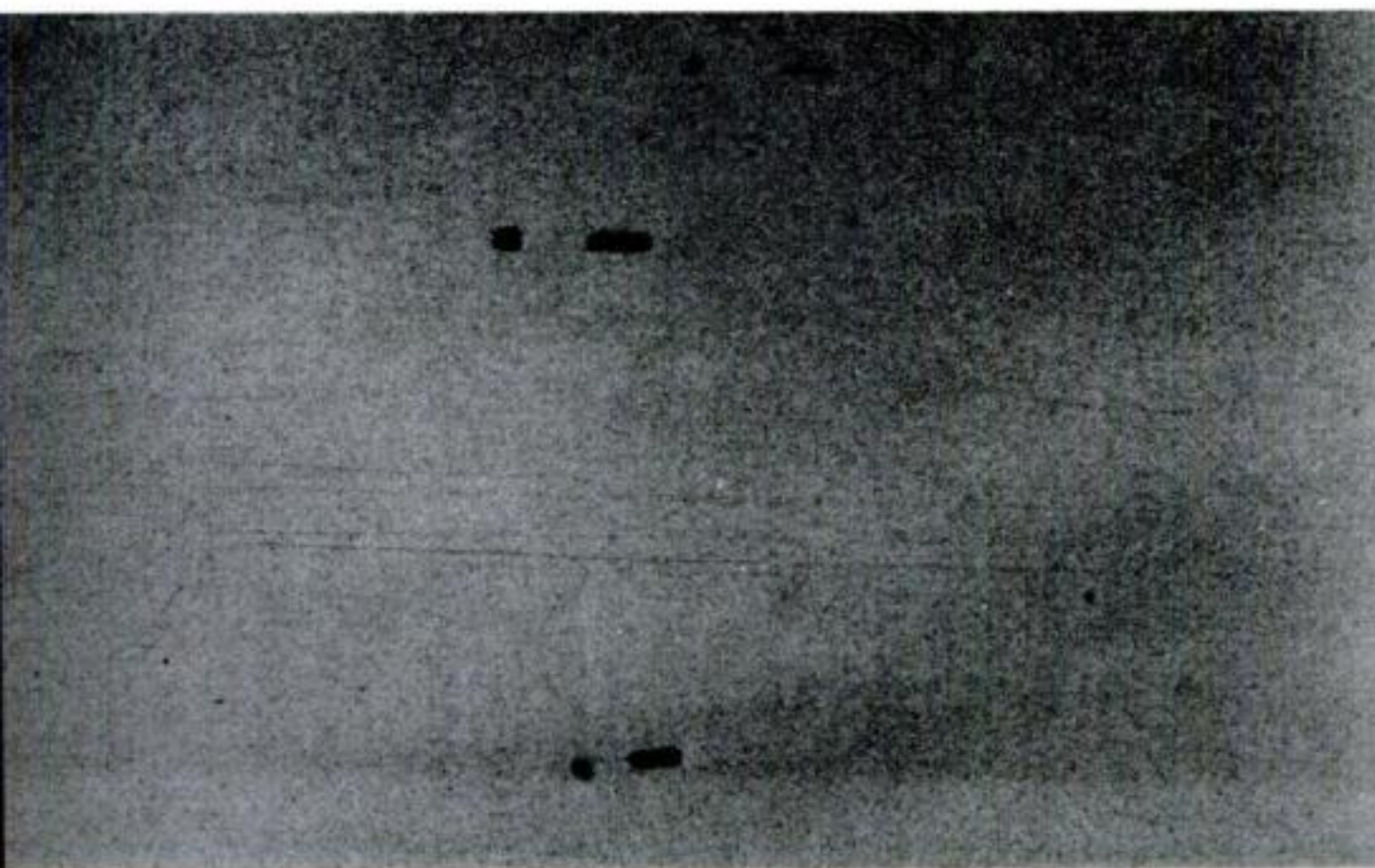
tion. Tiny Vanguard I's principal contribution has been successful trial of a radio transmitter powered by solar cells, capable of transmitting data for years—instead of the few weeks at most that chemical batteries last. While Vanguard I reports only temperature data, its 20-inch successors have been designed to carry much more elaborate scientific instrumentation.

Biggest upset in space lore comes from Sputnik I—and credit for it goes to the amateurs of Project Moonwatch, who tracked the 25-inch sphere of polished aluminum with little low-power telescopes. "With very few exceptions," says

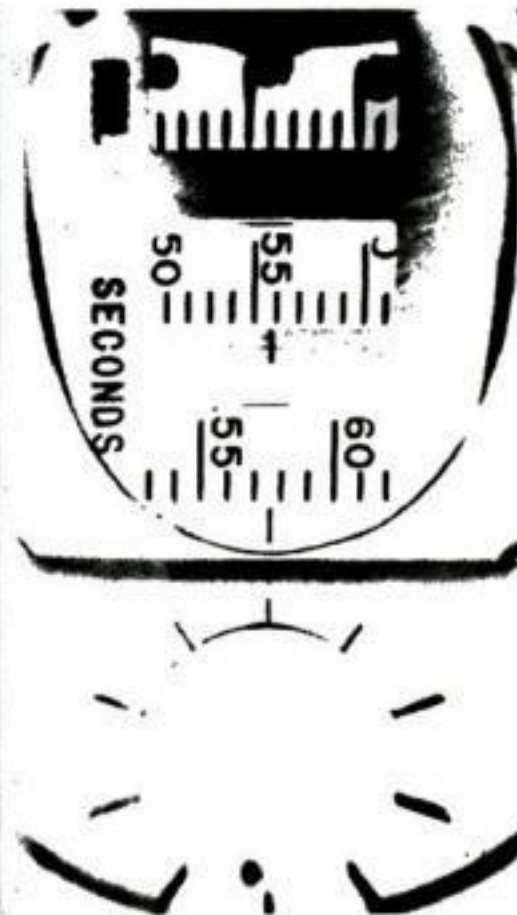
the Smithsonian Astrophysical Observatory, "the only scientifically valuable visual observations of the satellite proper were obtained by Moonwatch teams." From the observed orbit, the Observatory's scientists have announced a startling finding:

At satellite levels the atmosphere appears to be nearly *nine times* as dense as expected. While it's so thin that it still amounts to a near-vacuum—only about 1/3,000,000,000 as dense at 140 miles as at sea level, by the tentative new estimate—the difference from predictions strikes space planners like a bombshell.

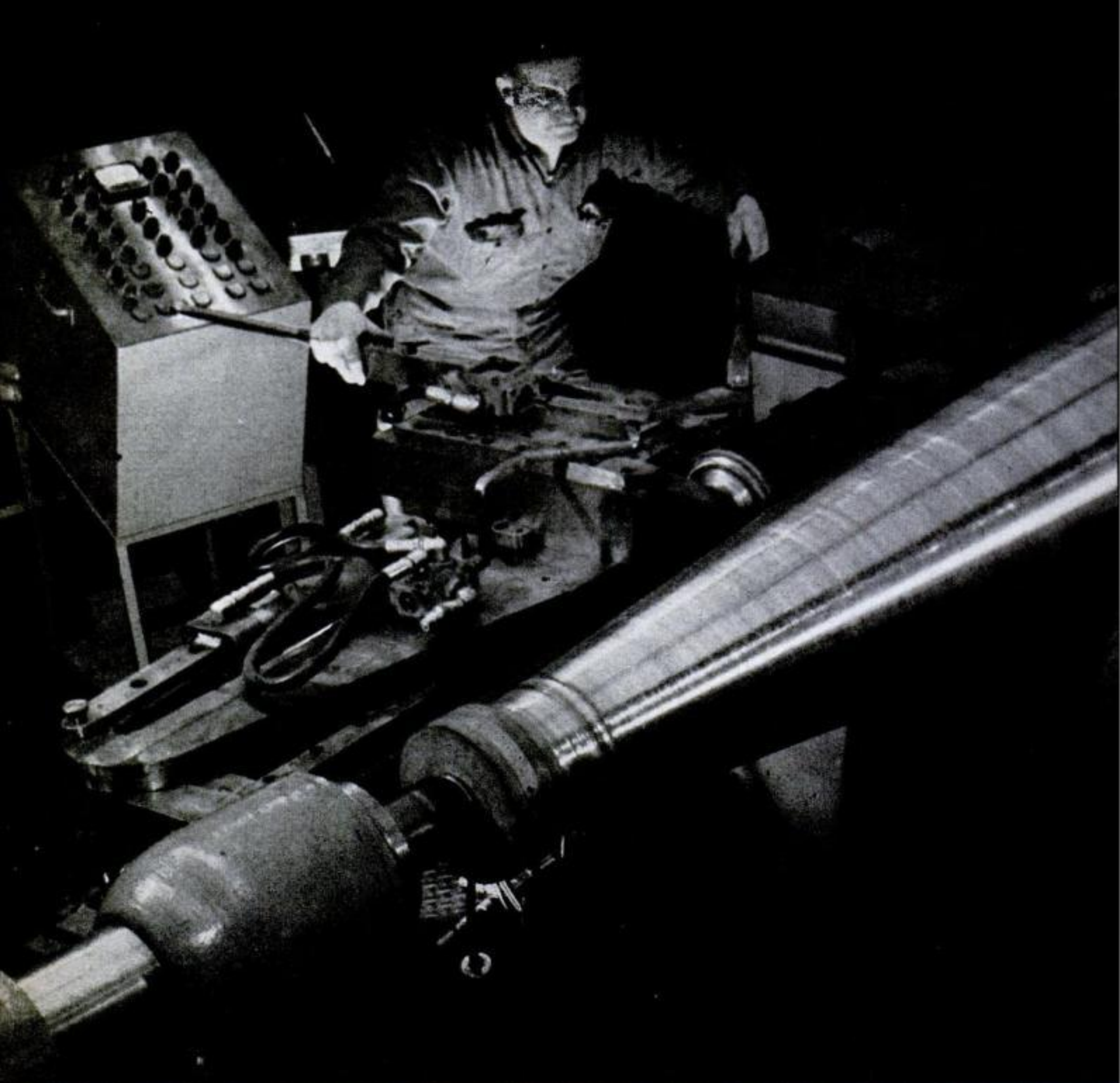
[\[Continued on page 228\]](#)



nik I rocket. Motions of camera "stop" and "smear" the satellite (lower black marks), and star (upper black marks) from which its posi-

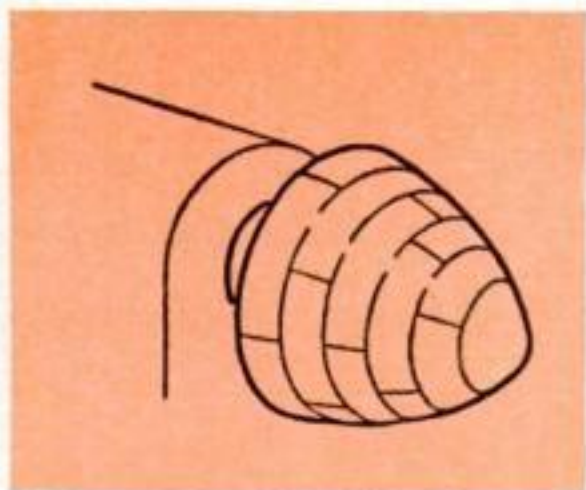


tion will be measured. The film simultaneously registers time, from crystal clock, to accuracy within 1/1,000 of a second.

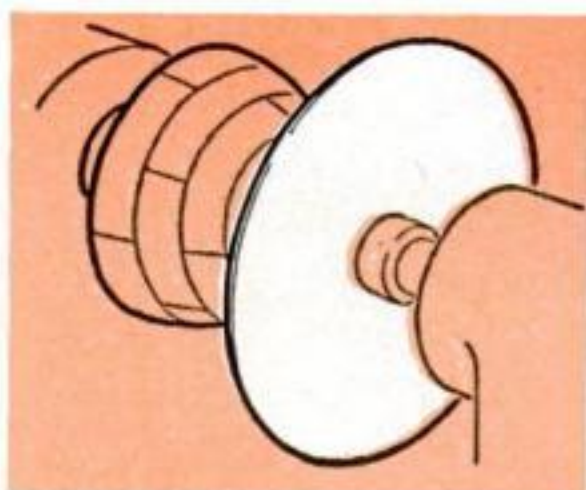


Cone rolled of sheet metal is spun over a form at Phoenix Products Company, Milwaukee,

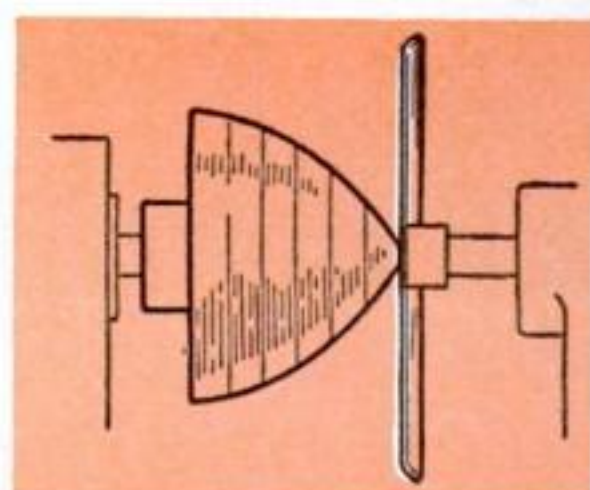
Motion and pressure stretch metal by cold flow



FIRST STEP: Form of desired metal shape is turned of wood.



METAL BLANK, a flat disk, is held against the form so that it is forced to rotate with it.



SET IN MOTION, the disk is lubricated and its edge bent up to keep it from buckling.



Spinning Strange Shapes for the Space Age

Giant lathes, molding metal as a potter's wheel does clay, make things to go out of this world

ONE of the oldest of metalworking arts now helps build for the age of space. Spinning is a technique by which three-dimensional shapes are made from sheet metal. Many such spun parts are used in modern missiles, high-altitude balloon gondolas, and atomic power plants.

Metal spinning consists of rotating a flat disk, a cone or a cylinder together with a form of the desired shape, and gradually working the metal against the form by the pressure of blunt tools.

Even when this operation is done cold, the metal flows and stretches under the tool. Recalcitrant metals and complex

to streamlined shape needed in missiles.

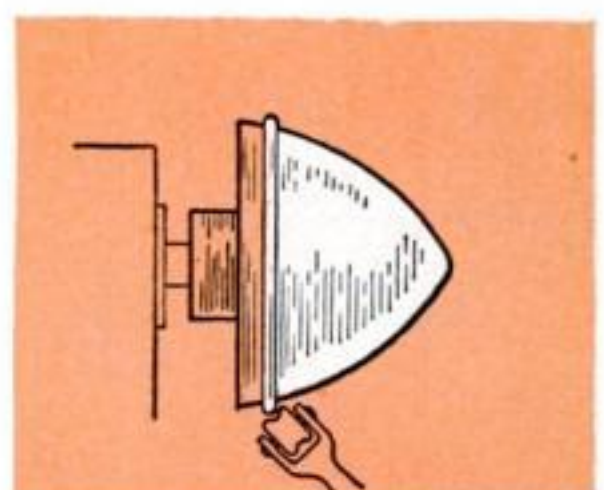
PHOTOS BY W. W. MORRIS



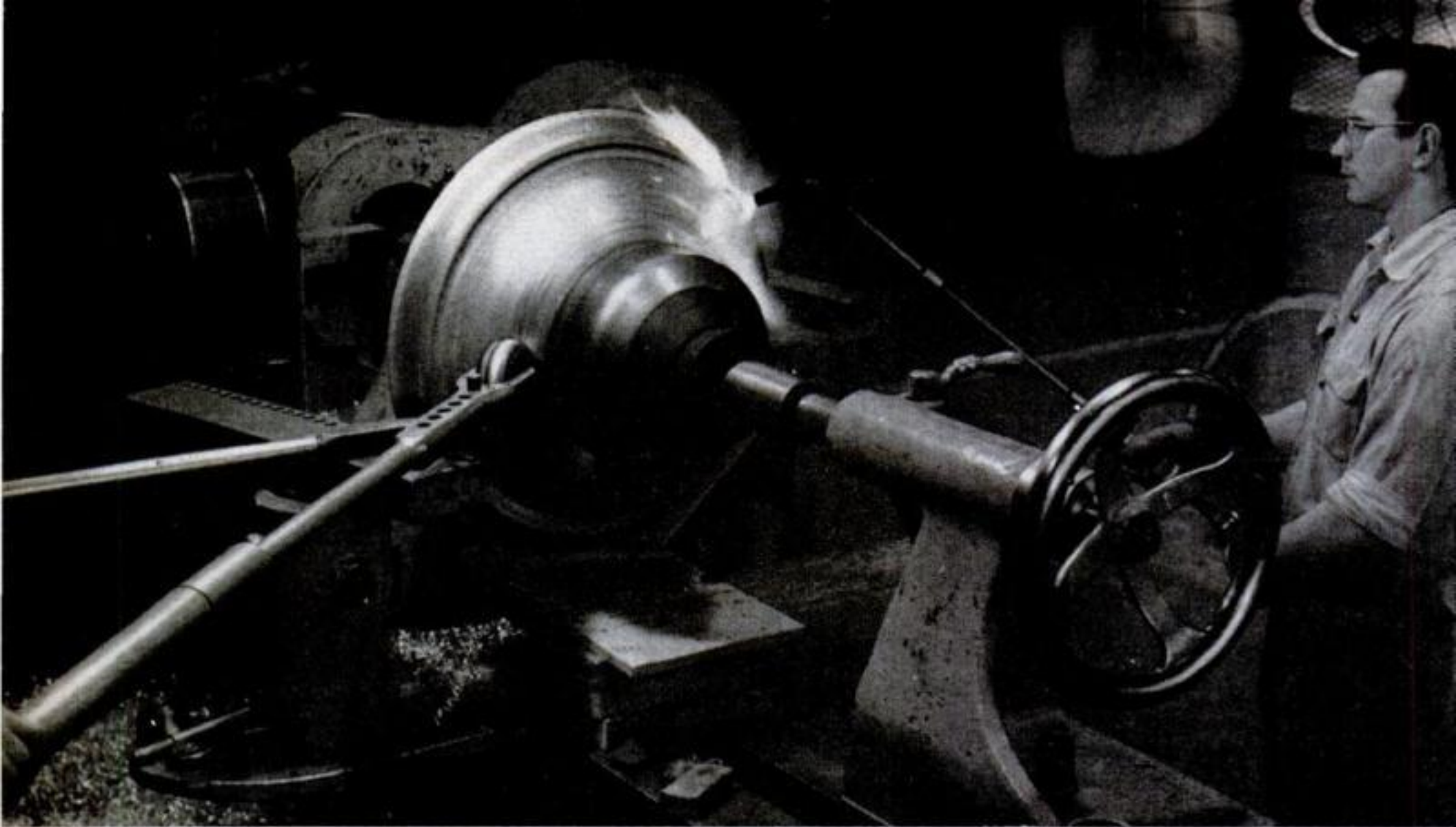
SMOOTH-NOSED TOOL is now pressed against the spinning disk, starting at the center.



TOOL IS KEPT MOVING both ways to keep metal thickness uniform as the spinner forces it farther and farther over the form.



REMAINING EDGE may be rolled over into a bead to add strength, or may simply be trimmed off.



BRAIN CASING FOR A MISSILE is spun with aid of flame. The work-hardening 5/32-inch-thick aluminum alloy used must be continuously an-

nealed during spinning. Form is of steel to withstand annealing heat. The work is done in three stages, and photos above show the final one.

shapes may be spun with the aid of heat.

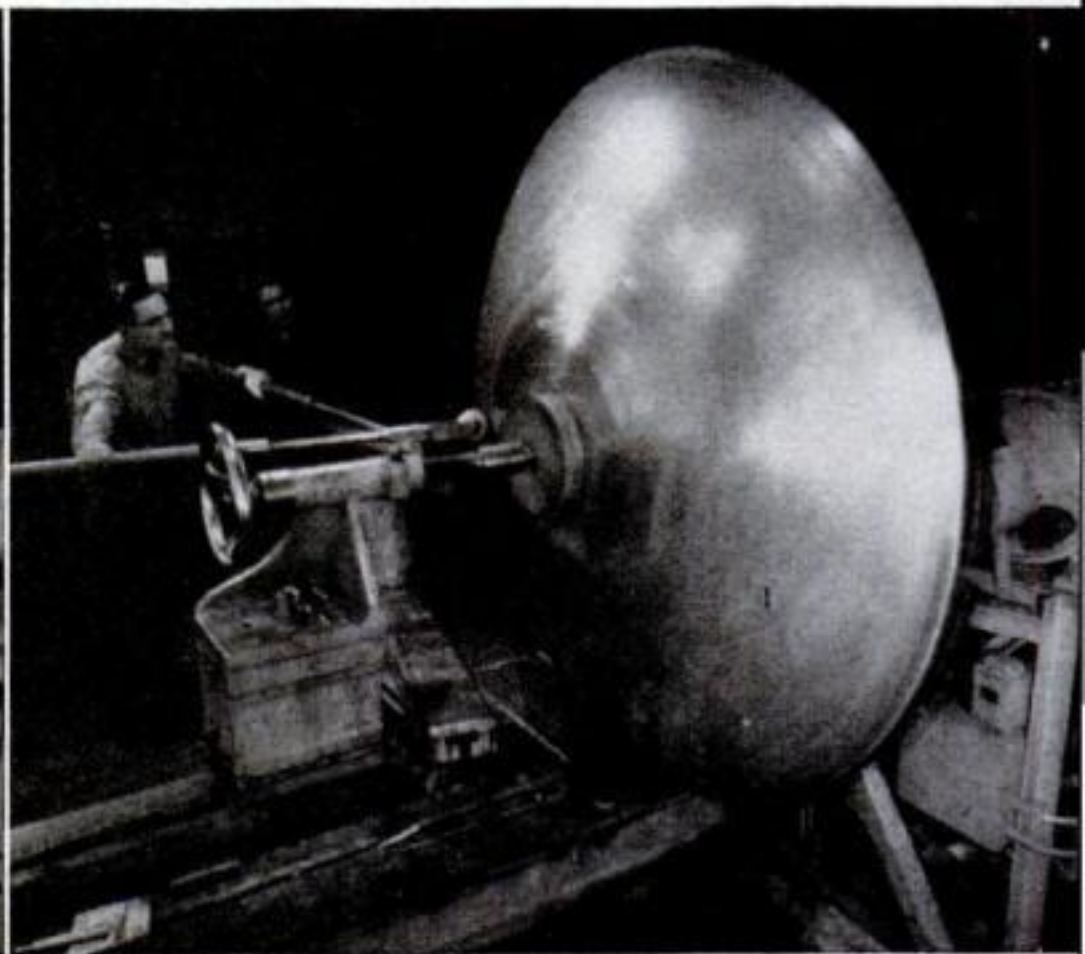
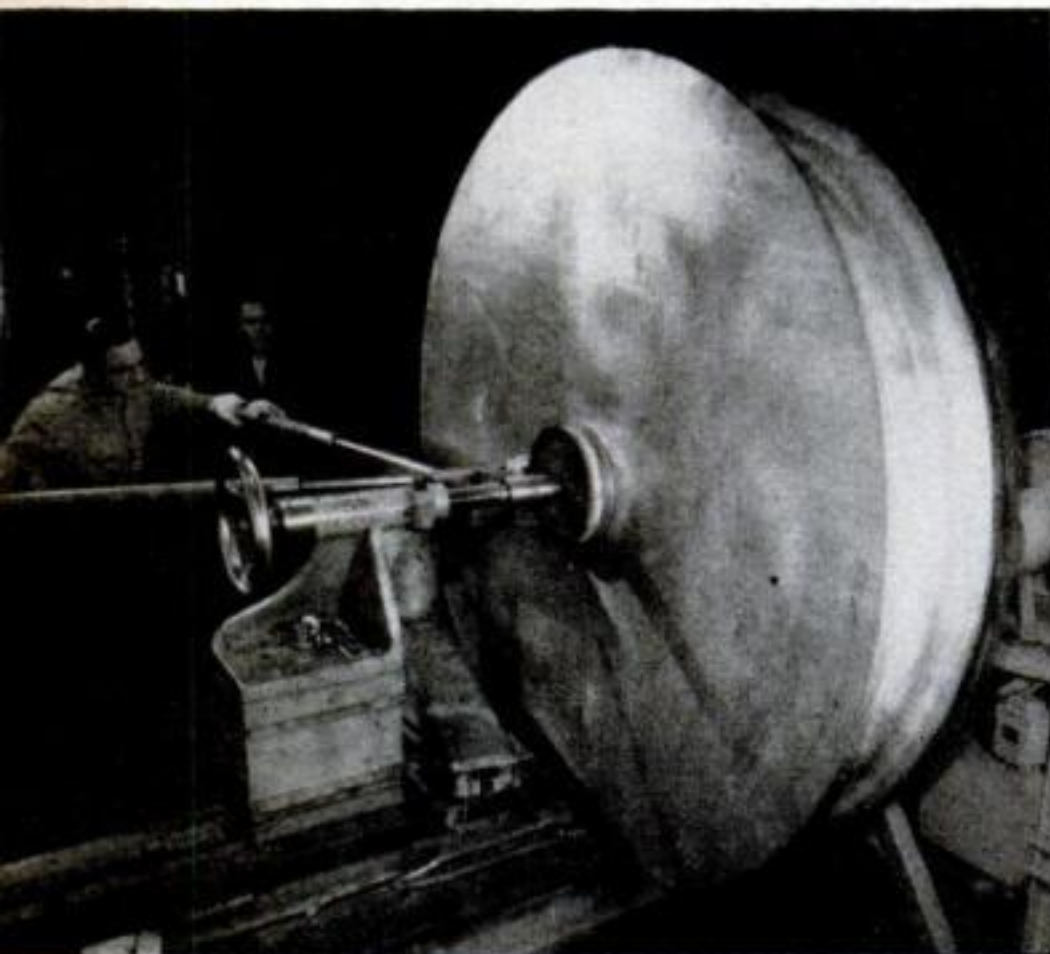
Tool marks found on Egyptian artifacts suggest that the ancients were familiar with this technique. Thanks to hydraulic-powered lathes pioneered by Spincraft, Inc., it has kept pace with modern metal-

lurgy and our need for huge, difficult-to-make shapes in the missile age.

Because hydraulic power multiplies the tool pressure while affording precision control, aluminum alloys, titanium, inconel, stainless and chrome-molybdenum

BULKHEAD FOR JUPITER: Dwarfed by the eight-foot blank in his huge lathe, the spinner below is making a fuel-tank bulkhead for the Army's big missile. The long-handled tool and its ful-

crum pin are both worked by manual effort alone. Below at left, the blank is in place. At right is the finished bulkhead spun over its wooden form and ready for removal.





The tool end has a roller on it, and is controlled by the spinner. His helper (at upper left, above) controls long-handled fulcrum pin

on which tool lever pivots. Tolerance is .010 inch on diameter and edge thickness. Photos were taken at Spincraft, Inc., Milwaukee.

steel, all vital in missile work, are now spun with the aid of automation to tolerances and in gauges formerly impractical.

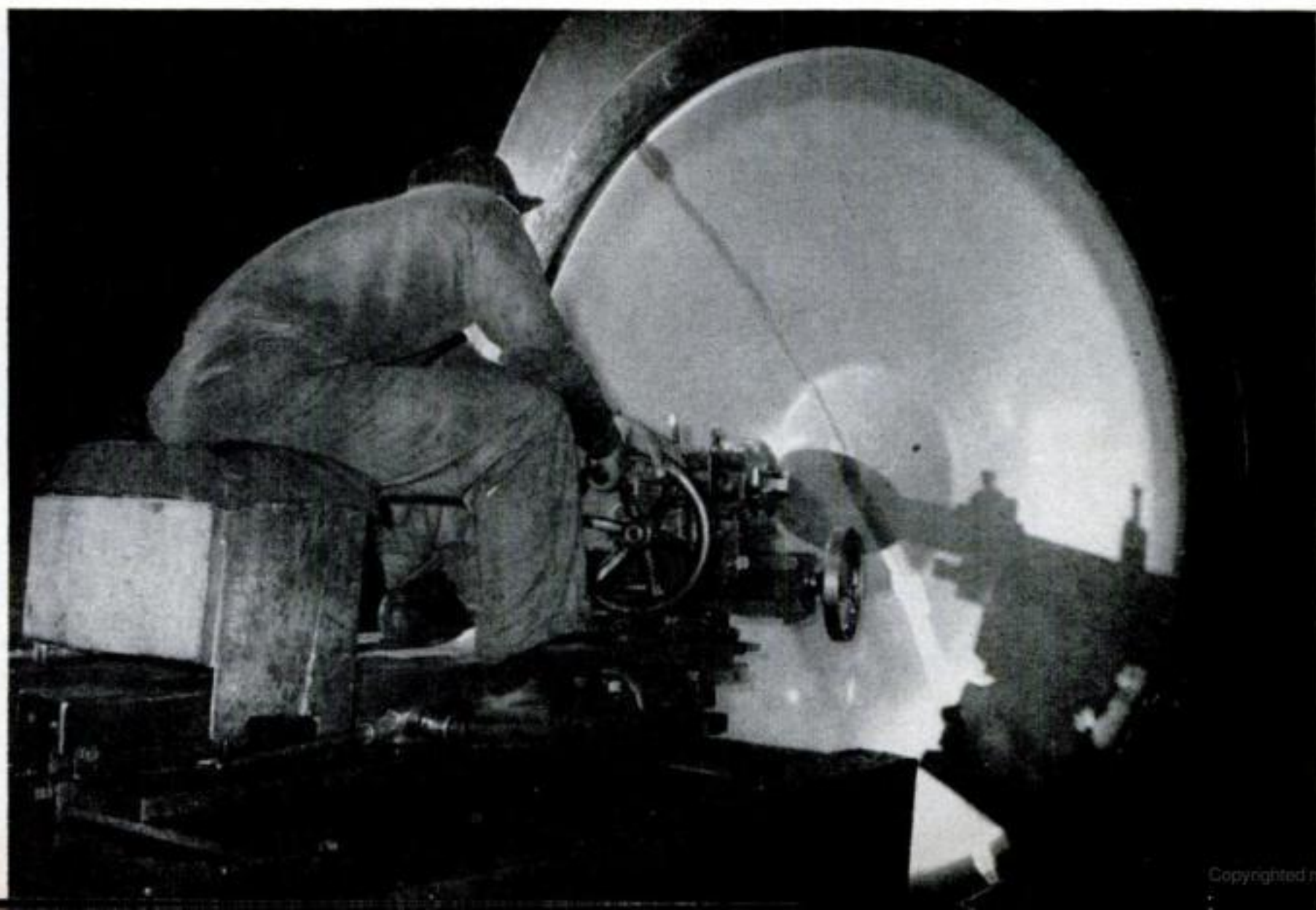
Yet so versatile is the process that the same plant may turn out stainless-steel dog dishes and missile bulkheads, TV-

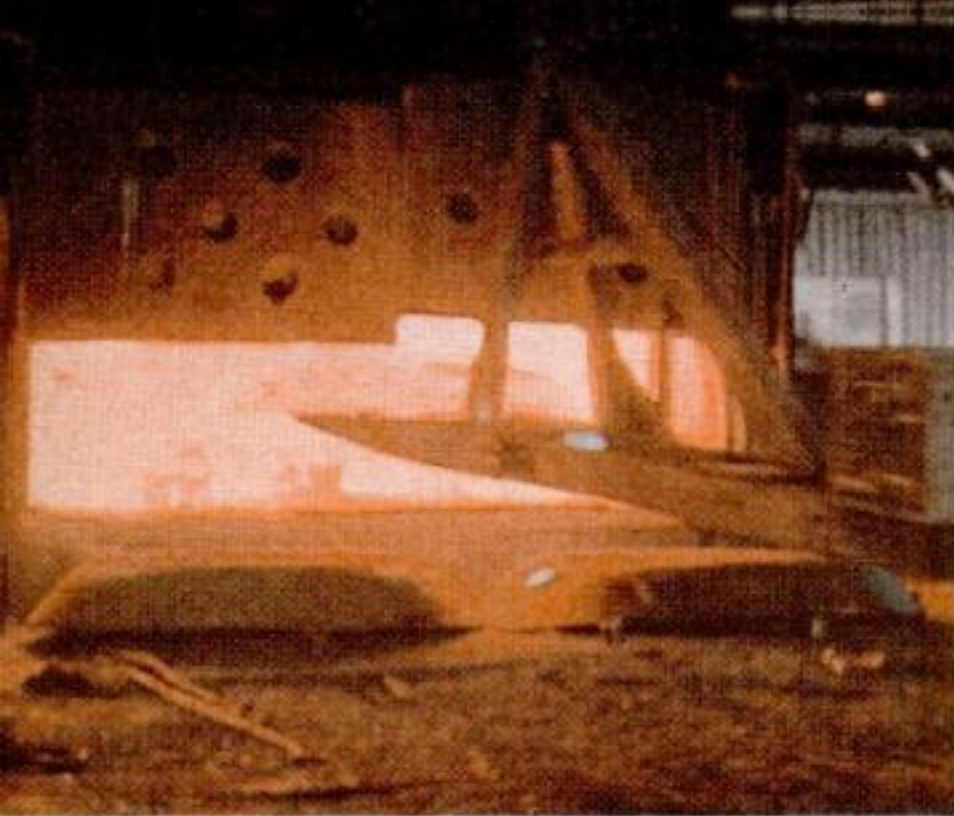
tube shells and rocket-fuel tank heads.

The accompanying photos show some missile parts in production. Pictures on the following page show heavy steel heads being spun at red heat for more down-to-earth applications.

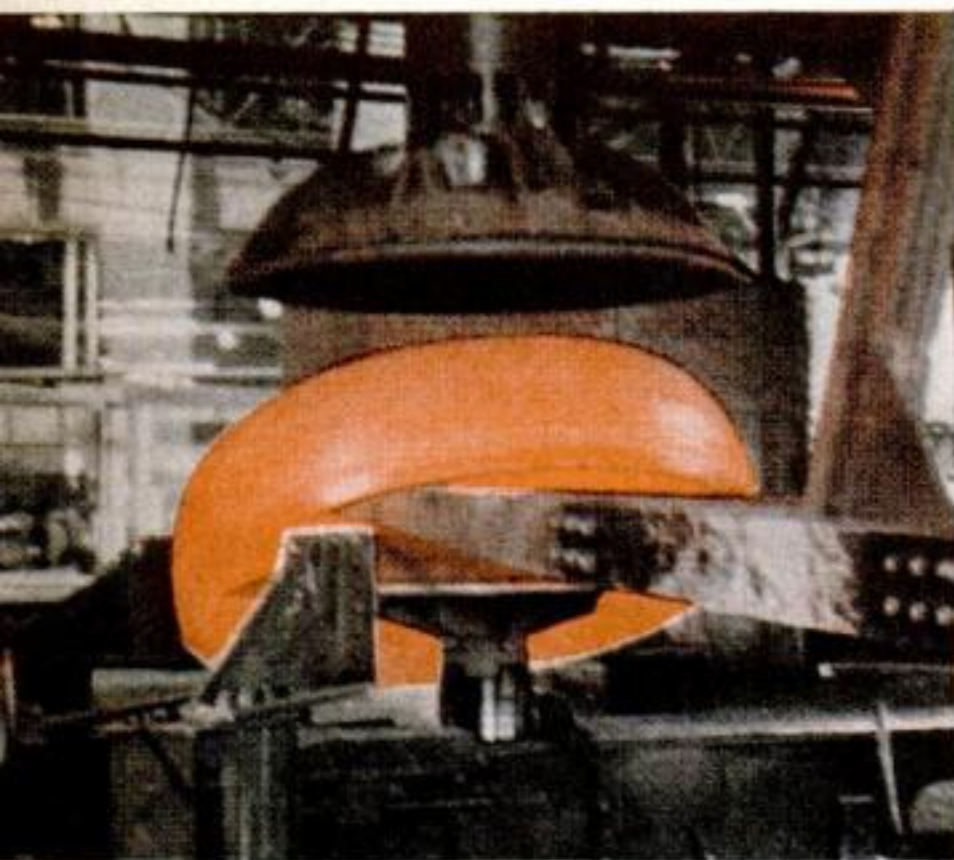
HEAD FOR A TANK that will feed liquid oxygen to missiles is spun from 10-gauge stainless steel. The form is concave. The spinner rides a power-driven tool carriage. Ball-ended tool is worked

from center to edge and back again for six passes, spinning the metal inward against the form. Like bulkhead at left, this is a job at Spincraft's Milwaukee plant.

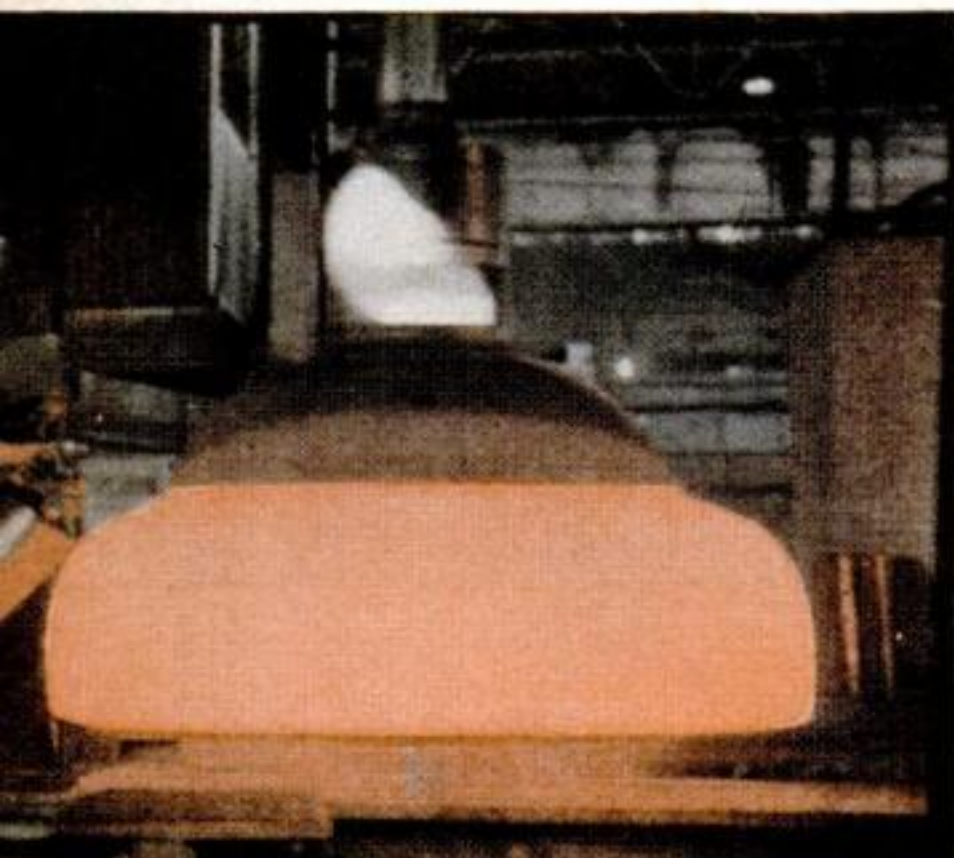




THE FORKLIKE PEEL deftly enters blazing furnace to lift out a red-hot steel blank.



NUDGED ONTO THE FORM, the workpiece is centered by guides as the peel withdraws.



SPINNING AT RED HEAT, steel several inches thick is flanged over by power roller at left.

Glowing steel is spun on gigantic lathes that stand on end

COVERING several acres of floor space is a metallic jungle of weird shapes: huge cast-iron domes and great disks of steel. As you step through the cindery dust, a warning klaxon sounds. Behind you, a hook glides by on a steel cable hanging from an overhead crane.

A second hook descends behind it, both falling onto two girders joined with a tripod at their middle and counterweighted at one end. This is the peel, which picks up red-hot steel just as you might lift a biscuit with a fork. Only two cables control the peel and its dangerous load.

As the door of a furnace rises, the tines of the peel enter its white-hot maw, nudge beneath a disk or partly shaped head, and emerge with several thousand pounds of lethally hot metal. Again the klaxon sounds. The peel slides sideways, stops, advances toward an iron mushroom set in the world's largest spinning lathe (276 inches). The fork lifts, drops its glowing charge, nudges it straight, and retreats.

Four guides on diagonal tracks center the hot blank on the form. From above, a follower clamps down. The mass begins to turn, becomes a ring of fire. A roller, controlled by an operator inside a cage, emerges from the left. It screams into motion on contact with the spinning metal. White sparks streak off as it bears down, forcing the edge over. On the floor the flanger, crouched down to see better, signals the operator. A second roller slides from inside the spinning bowl against its rim. The quadrant roller turns the edge under, both rollers withdraw, and the spinning dome rolls to a stop.

So a steel tank head is formed in the flanging shop of the Lukens Steel Company at Coatesville, Pa. It may be over 20 feet across and up to six inches thick. In many cases the work must be reheated several times or spun on successive forms.

When the head is cold, the center is punch-marked, a trammel point set in the dimple, and a motor-actuated head at the other end of the trammel rod switched on. It slowly swings an acetylene cutting torch around the rim, leaving a clean-cut, flame-polished edge.—*Harry Walton.*



Trials of the Jet-Age Traveler

IF YOU'RE one of the many who feel that an airline timetable is second only to an income-tax form in complexity, wait until you see a typical schedule for a jet transport. Flying around the world at nearly the speed of sound will throw your eating and sleeping schedules off as never before. To give you an idea of the problem, Boeing Airplane Co., Seattle, has worked out a flight schedule for a round-the-world trip on its near-sonic 707. (See table below.)

On such a flight, a passenger will fly through time zones faster than ever before. You can make the *mental* adjustment by simply resetting your watch while whizzing over the time zones of Paris, Beirut or Karachi. But your body doesn't change its routine so easily. On a jet trip, the people who live in the next city on your route may be quitting work when your body says it's time to turn off the alarm clock and greet the dawn. Your appetite says breakfast when it's really time for dinner.

The airlines are already anticipating these problems. They are planning their flights and meal service to cut down the conflict between their timetables and yours. However, there is no pat answer to the problem. Jet-age passengers will have to live through a little inconvenience. Says Boeing, "The long-distance

traveler must ignore his stomach—or the sun. Or he can go by slow boat."

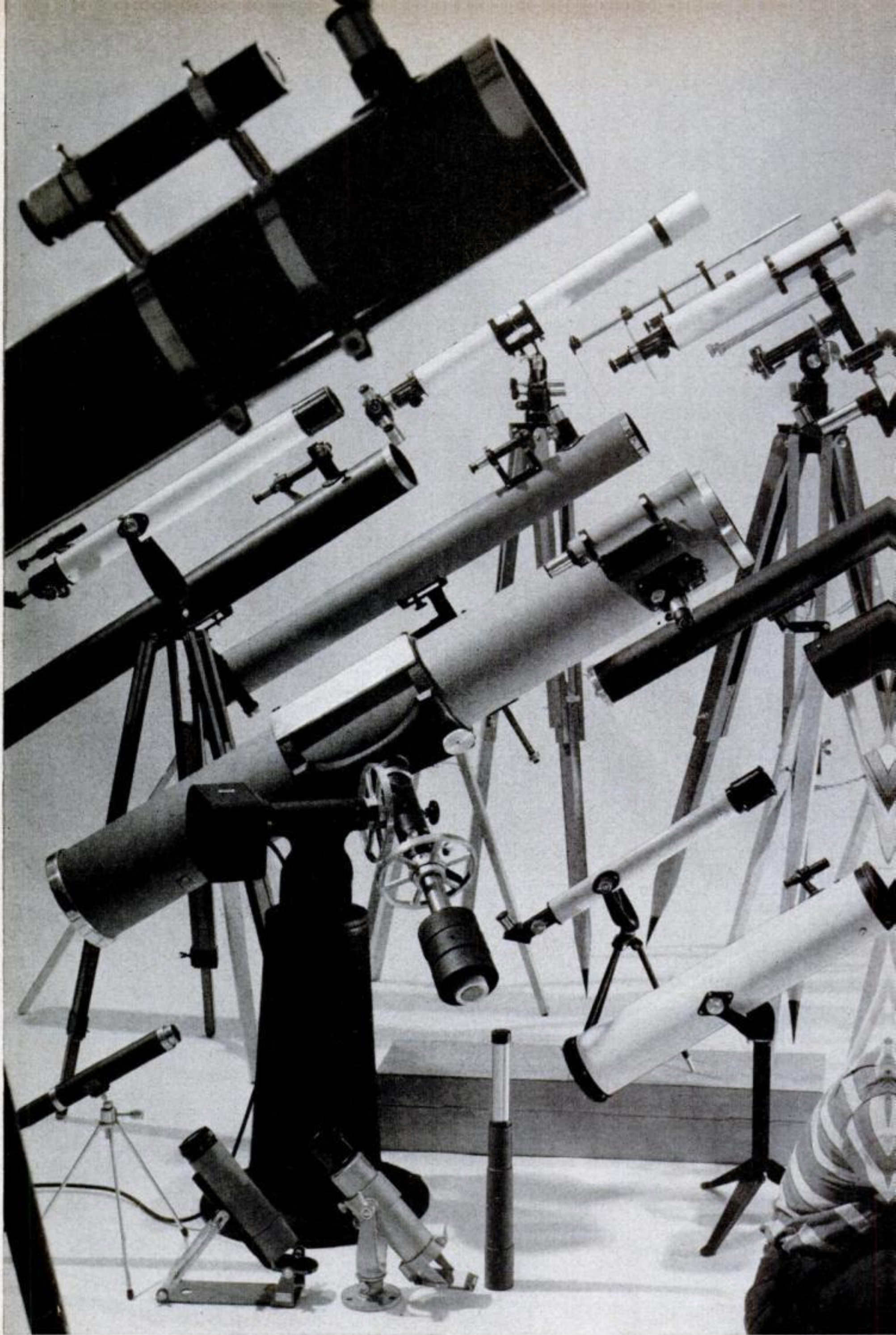
Whether you fly eastward or westward, time somehow escapes you either way. From Seattle to New York to Europe and the Orient, the time zones will fly by at a great rate. You would see the sun rise three times within 48 hours, measured by your own local time. Going west you travel with the sun. Because of the 707's speed and the distribution of time zones you would lose only an hour every few thousand miles. You would see only one dawn during the whole trip.

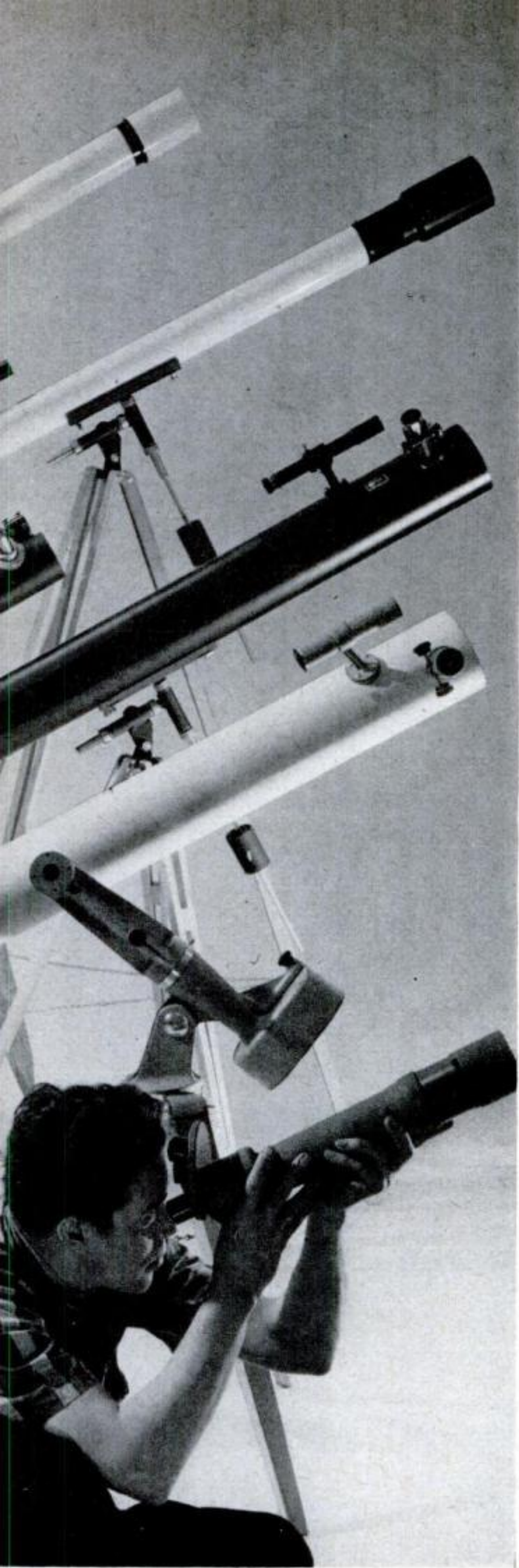
But that's only the beginning of this 24-hour confusion. After leaving Paris going eastward, for example, a traveler's Saturday would last only 13 hours. Flying through a short Sunday would bring him to Tokyo. The departing day from Tokyo would be Monday. But Sunday would come back again as the traveler crossed the international date line over the Pacific Ocean on his return to Seattle.

Flying the other way, westerly, you find jet speed again making your watch virtually useless. A tourist could spend most of the day in Paris, and, flying on a 707, arrive in New York in time for dinner. Then, say he's going on to Seattle—a flight of a little over four hours. Leaving New York at 10:30 p.m., he would arrive before midnight.

AROUND-THE-WORLD TIMETABLE

EASTBOUND			WESTBOUND		
STOMACH TIME (Seattle)		ZONE TIME	STOMACH TIME (Seattle)		ZONE TIME
4:00 pm Friday	Lv Seattle	4:00 pm Friday	4:00 pm Friday	Lv Seattle	4:00 pm Friday
8:12 pm	Ar New York	11:12 pm	1:10 am Saturday	Ar Tokyo	6:10 pm Saturday
9:00 pm	Lv New York	Midnight	5:00 am	Lv Tokyo	10:00 pm
3:10 am Saturday	Ar Paris	12:10 pm Saturday	10:09 am	Ar Saigon	2:09 am Sunday
7:00 am	Lv Paris	4:00 pm	11:00 am	Lv Saigon	3:00 am
10:55 am	Ar Beirut	8:55 pm	4:18 pm	Ar Karachi	4:18 am
Noon	Lv Beirut	10:00 pm	5:00 pm	Lv Karachi	5:00 am
3:40 pm	Ar Karachi	3:40 am Sunday	8:40 pm	Ar Beirut	6:40 am
5:00 pm	Lv Karachi	5:00 am	9:30 pm	Lv Beirut	7:30 am
10:18 pm	Ar Saigon	2:18 pm	1:25 am Sunday	Ar Paris	10:25 am
11:30 pm	Lv Saigon	3:30 pm	9:00 am	Lv Paris	6:00 pm
4:50 am Sunday	Ar Tokyo	9:55 pm	3:10 pm	Ar New York	6:10 pm
7:00 am	Lv Tokyo	Midnight	7:30 pm	Lv New York	10:30 pm
4:10 pm	Ar Seattle	4:10 pm Sunday	11:42 pm	Ar Seattle	11:42 pm





Suddenly Everybody Wants a Telescope

Sales zoomed with the first Sputnik. Now an age-old hobby may become the latest fad

By Hubert Lockett

THERE is a new hankering abroad in the land—the itch to own a telescope. If you are a fan of amateur photography, ham radio, hi-fi, or model railroading, you are particularly susceptible. Actually, this delightful affliction has been around for a couple of centuries. But only since the Sputniks first flew has it shown promise of becoming epidemic.

As in any hobby that involves buying precision equipment, there are pitfalls awaiting the newcomer to telescopes that can be expensive and disappointing. Here are the facts you should know before you lay your money on the line.

Satellite caution. Scopes are fine for watching a satellite if you're talking about the old-fashioned, natural moon. But don't expect a close-up look at man-made satellites. You just can't aim a high-powered telescope with its limited field of view at a rapidly moving satellite and track it.

What do you want it for? The answer goes a long way toward determining the scope you want. There are two general

.....

TELESCOPES GALORE—yet this is only a sample of what's available. Prices of instruments shown start at around \$30 for a spherical reflector of 3½" aperture and run to \$475 for a 6" reflector with pedestal and motor drive. Other typical prices: 4" reflectors, \$50 to \$80; deluxe 4" reflector with motor drive, \$200; 2" to 2½" refractors, \$40 to \$125; 3" refractors, \$125 to \$435. Telescopes shown here are distributed by Criterion Manufacturing Co.; J. W. Fecker, Inc.; Edmund Scientific Co.; Unitron; Bausch and Lomb; Skyscope Co.; and Lafayette Radio.

Distance may lend enchantment, but a bigger thrill is

types: 1) spotting or viewing scopes, 2) astronomical telescopes. Viewing scopes, sometimes called terrestrial telescopes, are for earth-bound looking—checking targets, bird watching, hunting and general scenic exploration. They give an image that is right side up. (They can be used for stargazing, too. Craters on the moon, Saturn's ring or perhaps the moons of Jupiter are some of the fascinating sights that may be seen.)

But if you want a really good look at the wonders upstairs, you'll need an astronomical telescope with a proper mount. The upside-down image that you get with it makes no difference when you're looking at stars or planets, but the simplification this allows in the optical system gives you more see-ability for your telescope dollar.

Two basic types. Telescopes have either a *refracting* or a *reflecting* optical system. The refractor is what most people visualize as a telescope; the familiar spyglass is an example. The work of collecting light from a distant object and producing an enlarged image is done wholly by lenses. The primary image is formed by bending—refracting—light rays as they pass through the objective lens at the big end of the telescope. When you look through the eyepiece lenses at the small end of the telescope, you see this image enlarged.

Reflectors, though less a part of everyday experience, have much to recommend them. (The 200-inch telescope at Mt. Palomar is one.) In the classic Newtonian reflector, the image is formed by reflection of light rays from a concave mirror at the bottom (closed) end of the telescope tube. A small mirror or prism near the open end reflects the rays to the eyepiece mounted in the side of the tube (and near the open end). While the Newtonian is by far the most widely used by amateurs, there are other more sophisticated types, as well as hybrids that use both lenses and mirrors.

Well-made instruments using either mirrors or lenses can do a good job of fulfilling the chief functions of a telescope:

- To give a magnified image of the object viewed (magnifying power)
- To gather more light than the unaided eye (image brightness)
- To give distinguishable images of

two points separated by only a small distance (resolving power)

Power may seem to be an important statistic, but with telescopes it is nearly meaningless as a method of deciding value. A 100-power scope may be overpriced at \$4.98 while a 20-power job could easily be a bargain at \$40. (Power, incidentally, means magnifying capacity; a power of 60X indicates that the image you see in the instrument is 60 times larger than the object appears to the unaided eye.) Power is determined by dividing the focal length of the objective lens by the focal length of the eyepiece. If the focal length of the objective is 30 inches and that of the eyepiece is half an inch, the power is 60X. Obviously, you can change power simply by changing the eyepiece. In better instruments, the eyepieces are interchangeable so you can choose the most suitable power for the job at hand.

Image brightness is one limitation on the magnification that can be used. When the power goes up, the brightness goes down, if you keep the same objective.

If you want to compare two instruments on this score, focus a telescope on a distant object and then swing it to point at the bright sky. Back away from the eyepiece several feet and you will see a bright round disk of light that seems to be suspended in the air just in back of the eyepiece. This is the exit pupil of the telescope. If you measure its diameter, you'll find it is equal to the diameter of the objective (aperture) divided by the magnification. The size of this disk indicates the relative brightness of the image.

Sharpness of the image determines how much fine detail you will be able to see. This depends first on the quality of the optics in the instrument. Assuming equal quality of two telescopes, theoretically the one with the larger *aperture* will distinguish more detail. This is the effective diameter of the objective lens for refractors, or the main (concave) mirror for reflectors. The measure of this ability to render detail is the resolving power—the smallest angular distance separating two points that will still give separate, distinguishable images.

Aperture, then, is obviously the proper way to rate a telescope. With either re-

a close-up of the heavens

fractors or reflectors, this dimension really determines final performance.

The maximum magnification you can use with a given aperture is subject to some dispute among experts. Some say that 30X for each inch of aperture is about all you can count on. Others claim that under ideal "seeing" conditions, useful magnifications up to 70X or even 100X per inch are possible.

The problem is similar to that of watching a big-screen TV picture. You can see an apparently larger picture by moving closer to the set. But if you get too close, the picture will be less distinct than at some point farther away. You see the best picture when you are just close enough for the eye to resolve fully all of the picture information being presented.

In a telescope, the objective determines the total amount of picture information. The eyepiece simply enlarges the image the way you do when you move closer to a TV set. The eyepiece cannot *add* to the total amount of picture information.

How do the two basic telescope systems stack up on this all-important factor of aperture? On cost, the reflector has the edge. You can get more aperture per dollar in a reflecting telescope than in a refractor, which helps account for its popularity among amateurs. The refractors cost more for the same optical performance, but they offer advantages in convenience and ruggedness. You can also get a wider field of view with a refractor.

Aperture size fixes the limit of performance, but the optics must be accurately made and the inherent shortcomings corrected, if a particular instrument is to deliver up to this limit. In a refractor, for example, this means the objective lens must be *achromatic*—designed to bring all visible colors to the same focus. Reflectors do not have this problem, being intrinsically achromatic. With any instrument the eyepiece should be achromatic.

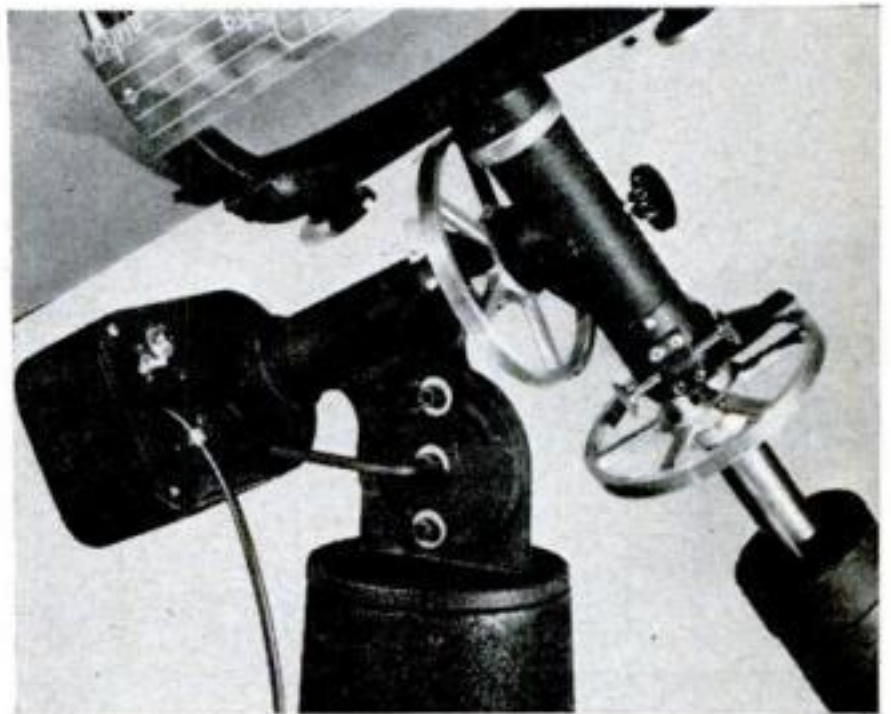
Light is lost by reflection at each glass-air surface in the lens of a refractor and some is absorbed in passing through the glass. Loss by reflection is reduced in any good modern refractor by anti-reflection coatings. You can spot a coated lens by the dull bluish cast to its surfaces.

Light loss in a reflector is determined

[Continued on page 232]



ALTAZIMUTH MOUNT provides independent motion in both vertical and horizontal planes. But it must be moved in both directions at once to follow the path of a star as the earth rotates.



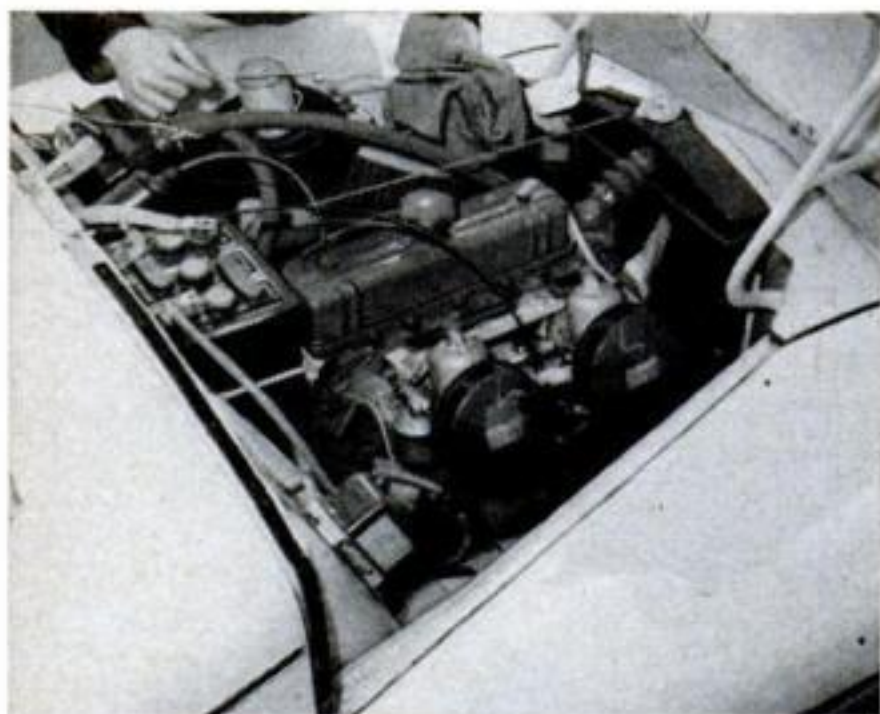
EQUATORIAL MOUNTS with the polar axis set parallel to the earth's axis can keep a star in view with movement in only one direction. A clock drive can match the earth's rotation.

What You Can See

Our own moon is the first thing you'll want to observe. Even a modest 1" scope at 20X magnification will show hundreds of surface details. But, to do justice to these sights, you'll need a 3" to 4" telescope. With it you can explore mountain ranges with peaks higher than Everest, vast plains, craters and the lunar "seas."

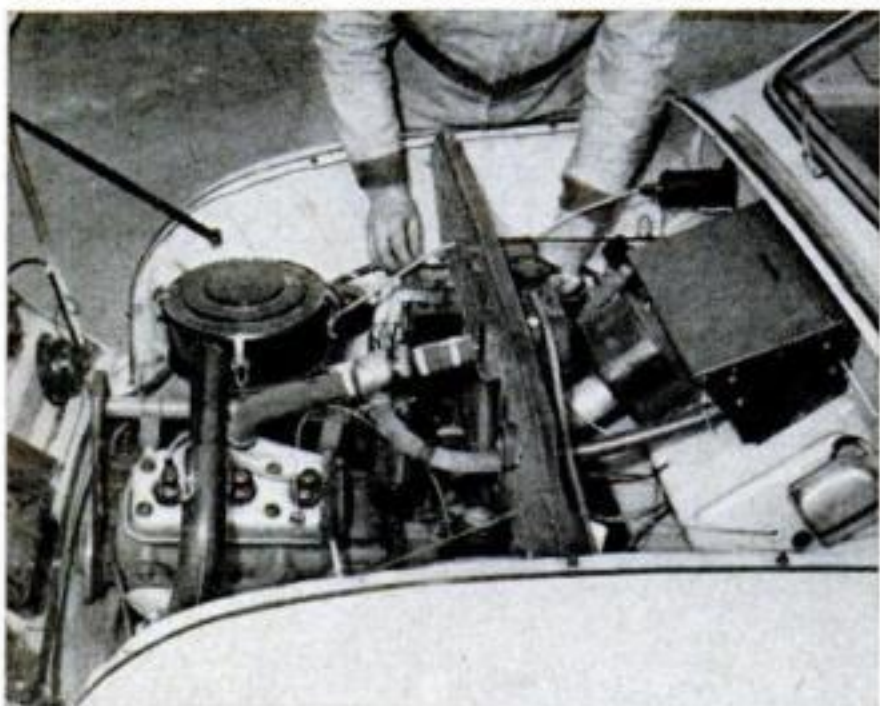
The planets Mars, Venus, Jupiter and Saturn are favorite targets. You will see these as disks with a 1" to 2" scope, as well as such details as the changing phases of Venus. With 2" to 3" instruments you can make out some of the markings on Jupiter and see four of its moons. Saturn's rings will be clearly visible. Telescopes 4" to 6" will bring out the white polar caps and the gray-green markings on the red planet, Mars; separate the rings of Saturn, show several of Saturn's moons and let you see the shadows of its moons glide across the face of Jupiter.

Driver's report on Saab and Volvo



VOLVO'S FOUR-CYLINDER ENGINE, shown above, has two carburetors. Like the Saab, it features a "window blind" air cut-off for fast warmups.

SAAB'S CANTED, THREE-CYLINDER ENGINE is at extreme front of the engine compartment. Radiator and cooling fan are against the firewall.



DISSIMILAR in power and size, Sweden's two contributions to economical motoring will register well above 20 miles to the gallon in stop-and-go driving.

By Devon Francis

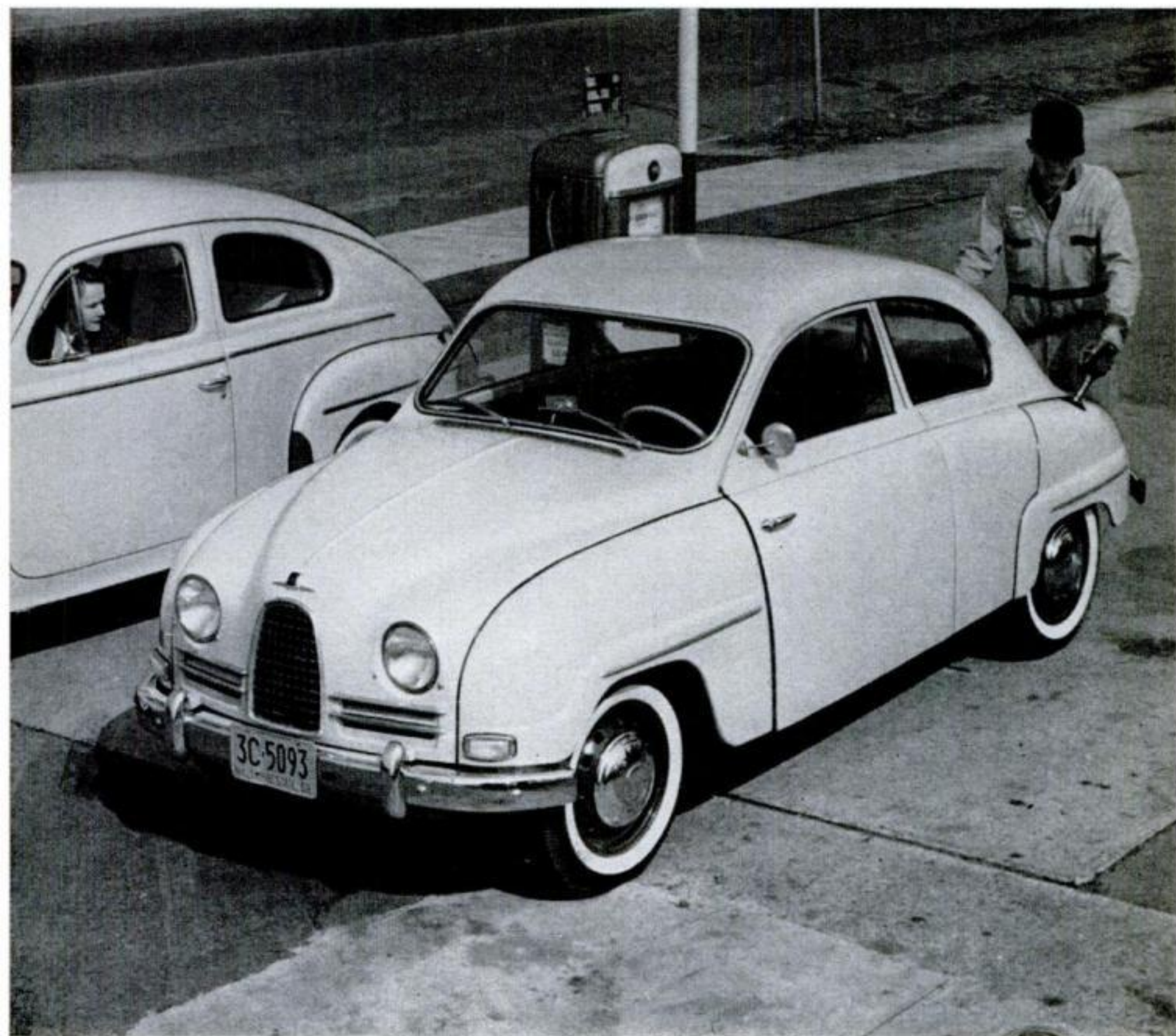
TWO brands of economical automobiles from Sweden have begun to endear themselves to U. S. motorists—along with the score of other European imports. In the order of their popularity over here, these cars are the Volvo and the Saab. In design and performance they are poles apart.

The Volvo is a conventional two-door sedan with a four-cylinder, 85-horsepower, overhead-valve engine under the hood.

The Saab is unique among the world's production automobiles. It, too, is a two-door sedan. But it's powered by a *three*-cylinder, two-cycle, 38-horsepower engine with, like most marine outboards, cylinder-wall ports in place of poppet valves. Its displacement, in fact, is little more than that of an outboard of about the same power.

The front wheels of the Saab, not the rear ones, are the driving wheels. Few front-wheel drives have been seen on U. S. highways since the Cord vanished.

...two little cars with a Swedish accent



The Volvo and the Saab are dissimilar, too, in performance and price. They do have a few characteristics in common.

Both run on pennies. They are well constructed and come surprisingly well equipped (by U. S. standards) for European machines. Both tote four persons. Both have high power outputs for the size of their engines. In American sports competitions for stock cars, both have won handily many events in their respective classes.

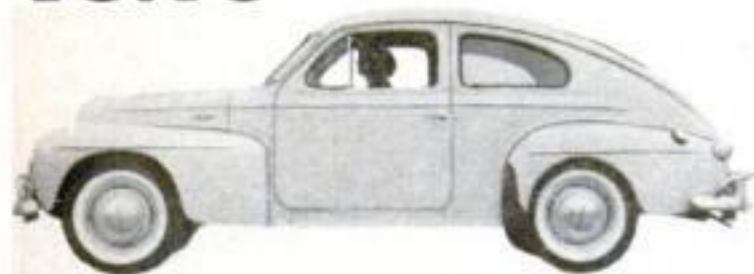
Here's what they are like:

Volvo PV444

This car is an almost unqualified delight to drive. Its engine is eager and obedient. It produces .87 horsepower for each cubic inch of displacement. Chevrolet's best 1958 engine produces .72 hp., Ford's .80 and Plymouth's—except for the esoteric Fury model—.71.

The clutch is smooth. The transmission-mounted shift lever moves crisply from one gear to another. Second gear is a real utility gear and a joy in traffic. A short wheelbase (though the Volvo is

Volvo



Price (East Coast port of entry).....	\$2,238
Wheelbase	102.5 in.
Length	177 in.
Width	62.5 in.
Height	60.2 in.
Weight	2,140 lb.

Performance

0-50 (indicated)	11.9 sec.
0-60 (indicated)	17 sec.
Top speed (indicated).....	92 m.p.h.
Speedometer error at 60 m.p.h.	3.5 high
Fuel consumption, stop-and-go	21.9 m.p.g.
Fuel consumption, constant 50	36 m.p.g.

Specifications

Engine	4 cyl. OHV
Displacement	97 cu. in.
Horsepower	85 at 5,500 r.p.m.
Torque	87 at 3,500 r.p.m.
Bore & stroke	3.125 in. x 3.15 in.
Compression	8.2:1
Transmission	3-speed manual
Axle ratio	4.55:1
Brake-lining area	144.4 sq. in.

Passenger space

Front-seat width	20.7 in. (each)
Front leg room	42.4 in.
Front head room	36.7 in.
Rear-seat width	42.5 in.
Rear leg room	38 in.
Rear head room	36 in.

bigger and heavier than the bulk of today's imports) gives it the customary European maneuverability.

The Volvo has a low noise level. Its entrance room is excellent, its head room greater than in any current U.S. car. The seats fold flat for sleeping two.

Like all cars, the Volvo has its debits. The styling is out of the late 1930s in the U.S., right up to its two-pane windshield. The body's sloping "fast back," combined with small rear-quarter windows, affords poor rear visibility.

A transmission tunnel that is 9½ inches high where the shift stick is mounted interferes with the accelerator toe. The heater on the car tested was only a marginal performer on a cold day. The car's cornering is excellent but (of course) the springing is pretty hard.

The engine is a stubborn cold starter. Engine vibration is excessive at idling speed. The body drums in second gear at 37 miles an hour. First gear needs synchronizing.

The panel is fully instrumented and well lighted, but after dark the controls on its bottom edge have to be located by feel.

The price makes the Volvo competitive with unadorned, stick-shift Chevies, Fords and Plymouths. It is considerably costlier than the Rambler American or the Studebaker Scotsman. Only 12,000 Volvos were imported in 1957. Some 15,000, all of which no doubt will be snapped up, will arrive this year. More than half the Volvos brought over are sold in California.

Saab 93

The Saab (a contraction of Svenska Aeroplan Aktiebolaget) was described in the June, 1957, issue of POPULAR SCIENCE as "astonishingly stable." It is. It's a lot more.

The Saab engine—which produces .82 horsepower per cubic inch—has less than half the displacement of the Volvo's, and the performance reflects it.

The car can be driven all day, without damage, with the accelerator on the toeboard. The front-wheel drive provides directional stability even when the going is slick, and the weight distribution obviates any need for putting concrete in the trunk for winter traction. Clutch and brake operate easily. A free-wheeling control, standard equipment, saves fuel on the open road and permits shifting without the clutch. The Saab pays no mind to winds lower than gale force.

The passenger compartment floor is flat—no transmission tunnel. Both front seats, exceptionally comfortable (like the Volvo's), have twice the normal fore-aft travel. Seats are available that fold down to sleep two. There are

little refinements, such as a flasher on the panel that warns when the gas tank is down to two gallons.

The Saab has won what the aficionados call competition "rallies" in this country with depressing regularity for the last couple of years.

The Saab's owners are passionately devoted to it, and criticism of it invites mayhem. Nonetheless, it has its faults.

The engine's torque output is skimpy. Second gear, necessarily much used in small cars, has little authority under 20 miles an hour. "Fast" steering with that weight on the front wheels makes women puff over the parking effort.

The necessity to add oil to the fuel complicates ministrations at the gas pump. Non-additive oil must be used—today's detergents visit ills on the engine—and the oil must be measured in a ratio of one part to 25. It's best to fetch along your own S.A.E. 40 in a can specially graduated at the pouring angle.

Clouds of blue smoke from the tailpipe on cold starts may curl a frau's lip, especially if a neighbor is looking. The engine sputters and har-rumphs on the over-run, and to the uninitiated its gasps are unnerving. Cylinder heads and cylinder-wall ports must be scraped free of carbon every so often at a cost of \$5 and an hour's time. The owner's manual says each 15,000 miles, the import office each 30,000 to 50,000. Take your choice.

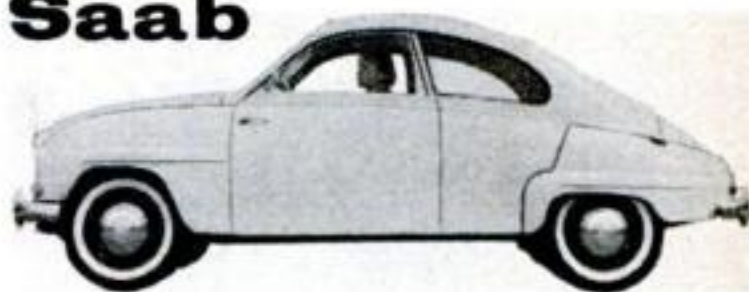
Like the Volvo, the Saab would never win a beauty contest before a panel of Detroit judges. It, too, has a "fast back" and limited rear visibility. Forward visibility is excellent. In place of vent windows, it has plastic deflectors at the top trailing edges of the door panes. This works fine for the front-seat passengers but is brutal on those behind.

The springing is hard. Shifting is easy, but the high lever position on second gear is annoying. The directional signals do not cancel. The obstruction of the front-wheel wells into the driving compartment forces the driver's left leg to assume a starboard list to reach the clutch. The transmission whines below 30 m.p.h. The first gear needs synchronizing when the free-wheeling unit is inoperative.

As yet, the Saab is sold only on the northeastern seaboard, as far south as Washington, D. C., as far west as Illinois. Last year 1,400 Saabs were sold in the U.S., and the prospects for 1958 are for 4,000. **END**

NEXT MONTH: *What's Detroit planning for 1959? Are the auto makers actually getting ready to manufacture small, European-type cars? For the answers, see PS for June.*

Saab



Price (East Coast port of entry).....	\$1,895
Wheelbase	98 in.
Length	158 in.
Width	62 in.
Height	58 in.
Weight	1,775 lb.

Performance

0-50 (indicated)	16.2 sec.
0-60 (indicated)	31 sec.
Top speed (indicated)	72 m.p.h.
Speedometer error at 60 m.p.h.	2 high
Fuel consumption, stop-and-go.....	24 m.p.g.
Fuel consumption, constant 50.....	38.2 m.p.g.

Specifications

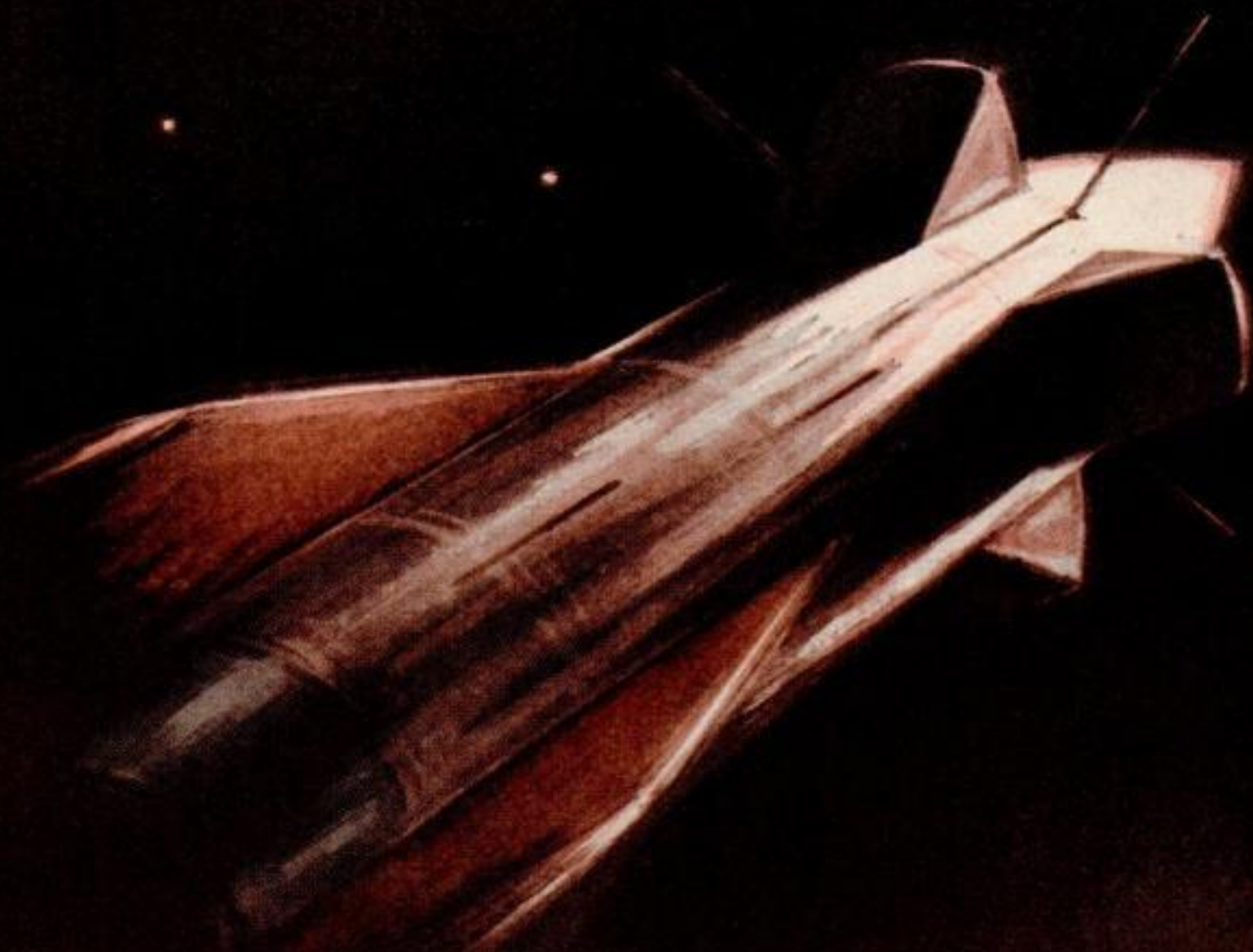
Engine	3 cyl. 2-cycle
Displacement	46 cu. in.
Horsepower	38 at 5,000 r.p.m.
Torque	52 at 2,000 r.p.m.
Bore & Stroke	2.59 in. x 2.87 in.
Compression	7.3:1
Transmission	3-speed manual
Axle ratio	5.43:1
Brake-lining area	90 sq. in.

Passenger space

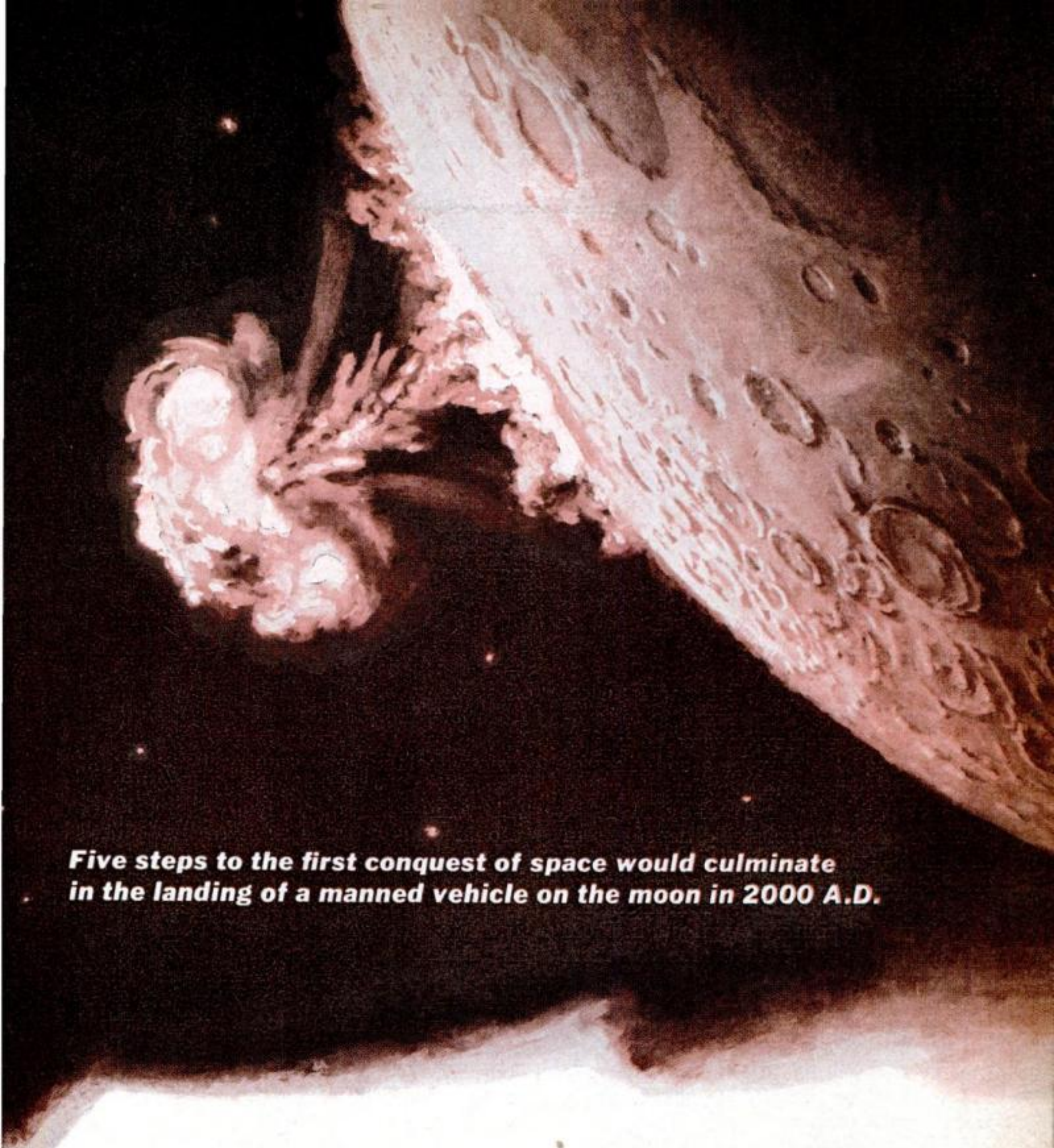
Front-seat width	18.2 in. (each)
Front leg room	42 in.
Front head room.....	38 in.
Rear-seat width	48.5 in.
Rear leg room	34 in.
Rear head room	35.2 in.

**U.S. scientist proposes
a realistic new**

Timetable to the Moon



ARMED with an atomic bomb, the first rocket will crash on the moon. . . When the lunar dust is highest, the second rocket will sweep in from the sky, skim down close to the moon's surface, and scoop up material in the dust cloud to return it to earth for analysis.



Five steps to the first conquest of space would culminate in the landing of a manned vehicle on the moon in 2000 A.D.

By Dr. I. M. Levitt

Director, the Fels Planetarium of the Franklin Institute

IN TONIGHT'S sky is a target—a round, silvery object some 240,000 miles away. It is large—2,160 miles in diameter. When examined with a telescope it is seen to be quite rough. We call it *the moon*.

For thousands of years man has dreamed of going to the moon. Today that dream is almost a reality. Many of the older people and all of the young who

read this will be around when a human being lands on the moon. This will take place by the year 2000 A.D.—give or take a few years. It may be longer if wars intervene to halt the rapidly accelerating technological advances. It will be shorter if a technological breakthrough like a nuclear-powered rocket materializes.

Manned flight to the moon cannot be initiated as a project in the immediate future. A tremendous volume of preliminary work must be completed first. Before we can think of landing on the moon

it will be necessary to establish a manned space station circling the earth as a base of operations.

There are steps, however, that can be taken in the immediate future—any moment now. The first is simply to aim a “something” at the moon and score a bull’s-eye. This is not a difficult task if one has the tools to build, aim and guide the “something.”



1958-1960: Marking the moon

The first man-made object to land on the moon will be a “marker” to tell scientists how close they have come to getting on target. It may be a container of fine glass beads, white powder or even a fluorescent dye blown apart by TNT.

There could be scientific benefit from this shoot—a more precise determination of the lunar mass. Accurate tracking of the rocket would help determine the moon’s pull at points along its path. From this information would evolve the mass of the moon.

A 30-pound payload would be necessary for this. If we assume that for every pound of payload delivered on the moon about 2,000 pounds of fuel and hardware are needed, we require a rocket with a total weight of about 60,000 pounds.

This three-stage rocket would stand about 80 feet high, with the first stage slightly over 55 inches in diameter.

While this is a theoretical rocket, the

Lockheed Missile Systems Division has fabricated a practical system. Their X-17 is a three-stage rocket capable of a speed of 24,000 feet per second. If this were scaled up, one more stage could add the extra 11,000 f.p.s. necessary to hit the moon.

Guidance for this marker system is not difficult to achieve. An ICBM guidance system, to perform satisfactorily, must possess a tolerance of a few tenths of a degree. But in aiming a rocket at the moon the error could be as large as half a degree! Thus in the guidance component of an ICBM we would have the guidance to put a payload on the moon.

Directional guidance is not the only problem, however. There is the question of proper speed at the cut-off point where powered flight ends and the rocket is to coast onward—or, as space planners say, is to be “injected”—into a lunar trajectory. George H. Clement of the Rand Corporation has investigated this aspect and his conclusions indicate that the cut-off speed must be rather precise.

At 350-mile altitude, which he assumes for the cut-off, or “injection,” point as a basis for calculation, escape velocity from the earth is 35,165 feet per second (about 24,000 miles an hour). That is, a rocket reaching this altitude at more than this speed would escape from the earth and circle the sun.

To project a payload from 350-mile altitude to a range of some 240,000 miles, the distance of the moon from the earth, a cut-off speed of 34,850 f.p.s. would be needed—a trifle less than the absolute escape speed. This velocity goes down slightly, to 34,800 f.p.s., if the moon is there to serve as destination; its gravitational field accounts for the difference of 50 f.p.s.

Actually the permissible variation in speed depends upon the precision of the angle of injection into the lunar trajectory. At best, the cut-off speed must be

The Moon as a Military Base

Pentagon planners are already calculating the wartime advantages that could result from control of the moon. They would be considerable.

According to Air Force Brig. Gen. Homer A. Boushey, established outposts on the

moon, armed with missiles, could have these vital strategic values:

1. Missiles aimed toward the earth from the moon could be watched and guided all the way from a single tracking station. But the opposite would not hold true, because of the earth’s rotation.
2. The nation maintaining a military base on the moon would have excellent protection

held within 50 f.p.s., or about 1/7 of one percent, of the intended figure.

The time needed to reach the moon is critically tied to this velocity. If the rocket leaves the assumed injection altitude with a speed of 34,800 feet per second, assuming zero error in the injection angle, the travel time will be slightly more than four days. If the velocity goes up to 35,000 f.p.s., time is cut to 2½ days. If the speed is 35,500 f.p.s., it's 1½ days.

The problem of seeing a marker on the moon is made difficult by our turbulent atmosphere. Atmospheric shimmer and distortion preclude the certain identification of most existing surface details less than one mile in diameter. This does not mean, however, that a man-made mark would have to be that big. Brightness—reflectivity—of the spot created by our fluorescent powder or glass beads would be an important factor. The minimum diameter of a spot we could observe with our 10-inch refractor at the Franklin Institute Observatory would be about 700 feet. But if we could use the 200-inch Hale telescope, a marker 35 feet in diameter could be seen. Thus the size of the spot to be seen depends on the aperture of the telescope used.



1962: A-bomb on the moon

The exciting next step will come a short time later when an atomic bomb is exploded on the moon. This payload

weighs between 60 and 100 pounds. Using the same hardware-to-payload ratio, this three-stage rocket must weigh over 100,000 pounds. The rocket may be 100 feet high and the diameter of the first stage will have to be increased considerably to house the additional fuel.

An atomic-bomb explosion on the moon would be visible to the naked eye of an observer on the earth. The intense energy of the bomb explosion would vaporize several thousand tons of the lunar surface to incandescence. Scientists on the earth could record the spectra of the explosion to determine the elements in this layer of the lunar surface. Thus some of the constituents of the lunar surface will become known.

Astronomers have considered the surface of the moon to be covered with a layer of dust or powder five or six inches thick. Our knowledge of its surface can only be derived from the study of reflected sunlight. The lack of any appreciable atmosphere on the moon precludes erosion by rain, wind and snow. But erosive effects are present.

The monthly changes in the temperature of the moon in going through a variation of several hundred degrees, the chipping away of the lunar rocks by the rain of meteors, the rapid change in temperature—from 160 degrees F. to minus 110 degrees F. in an hour—during a lunar eclipse, contribute to the wearing down of the rocks to create the dust that covers the lunar surface.

It is this complex dust that the astronomer would like to analyze. An atomic explosion on the moon might permit astronomers to verify their speculations.

An atomic bomb set off on the moon will dig a crater of large diameter—larger, because of the reduced gravitation, than it would on earth. The debris from the crater scattered over the surface of the moon will form a new spot perhaps a mile or more in diameter. This will be visible

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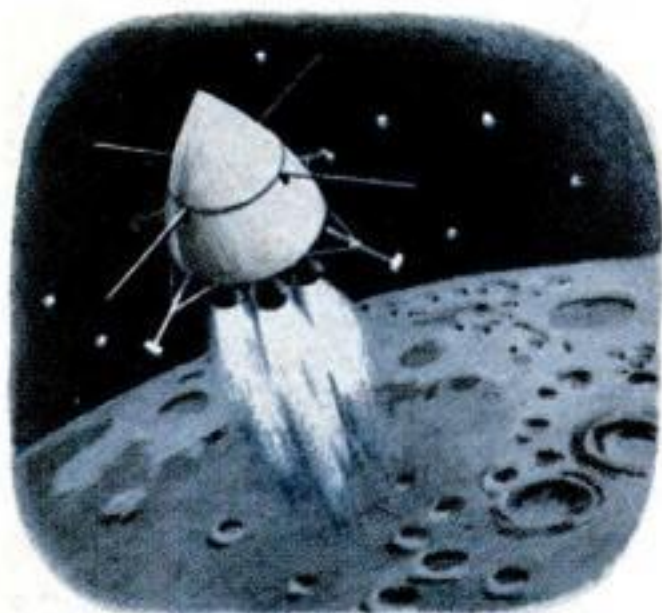
against surprise attack. Reason: If the moon base were attacked first, missiles would have to be launched several days in advance, with resultant loss of surprise. If the attack were made on the earth first, the moon base would be unharmed and ready to provide retaliation.

3. Additional advantages of a permanent military base on the moon would include

excellent earth surveillance; lessened gravity (an aid in launching missiles at the earth); virtual absence of atmosphere, reducing the blast effect of countermissiles; and the possibility of locating launching sites on the far, or shielded, side of the moon.

These considerations by the military planners are something to muse about the next time you see the moon riding the sky.

through a big telescope even though special markings have not been used.



1968: Instruments on the moon

The next step is the landing of an instrumented payload on the moon. In his paper for the Rand Corporation, Clement has also explored this possibility. He visualized the payload as consisting of 50 pounds of instruments and 50 pounds of power supplies for the instruments. This payload has to land safely on the lunar surface—to bring it down in a crash landing would surely destroy the instruments. For a 100-pound payload about 550 pounds of rocket must be used to brake the fall. Thus the total payload for a device of this type is 650 pounds.

To put this on the moon from the surface of the earth will require a 175-foot rocket of three stages, with the first stage about 14½ feet in diameter. The all-up weight of this rocket will be close to a million pounds.

Instruments placed on the moon 240,000 miles away will relay to the earth precise knowledge of the lunar surface. One instrument will measure lunar gravity. This can be done two ways. One is measuring the time it takes for a known mass to fall a known distance; the other uses the period of a swinging pendulum. With these relatively easy methods the gravitational field of the moon can be determined to one part in a thousand.

Scientists believe the moon must have a magnetic field. Whether this is true can also be determined instrumentally.

The use of a lightweight mass spectrograph could result in knowledge of the atmospheric density, if an atmosphere exists on the moon. If it does, astronomers believe it is less than 1/10,000 as dense as the earth's. Measurements of the density could go far below this limit.

Simultaneously with the efforts to land an instrument payload may come reconnaissance programs. In these the moon will be circled by rocket ships that will return to the vicinity of the earth. Many scientists have proposed such reconnaissance vehicles but one of the most sophisticated designs comes from Krafft A. Ehricke, of the Convair Corporation (PS, March).

His moon-circling rocket would exceed 100 feet in height and weigh 240,000 pounds. He visualizes it as a reconnaissance vehicle with pictorial information as the principal objective. Payload would weigh between 400 and 800 pounds and would include guidance equipment, a television camera, and radio gear. The first objective will be a photo-reconnaissance of the lunar surface including the other side of the moon. If this materializes, the astronomers will be able to compare the moon's two sides—the one we always see and the one we never see.

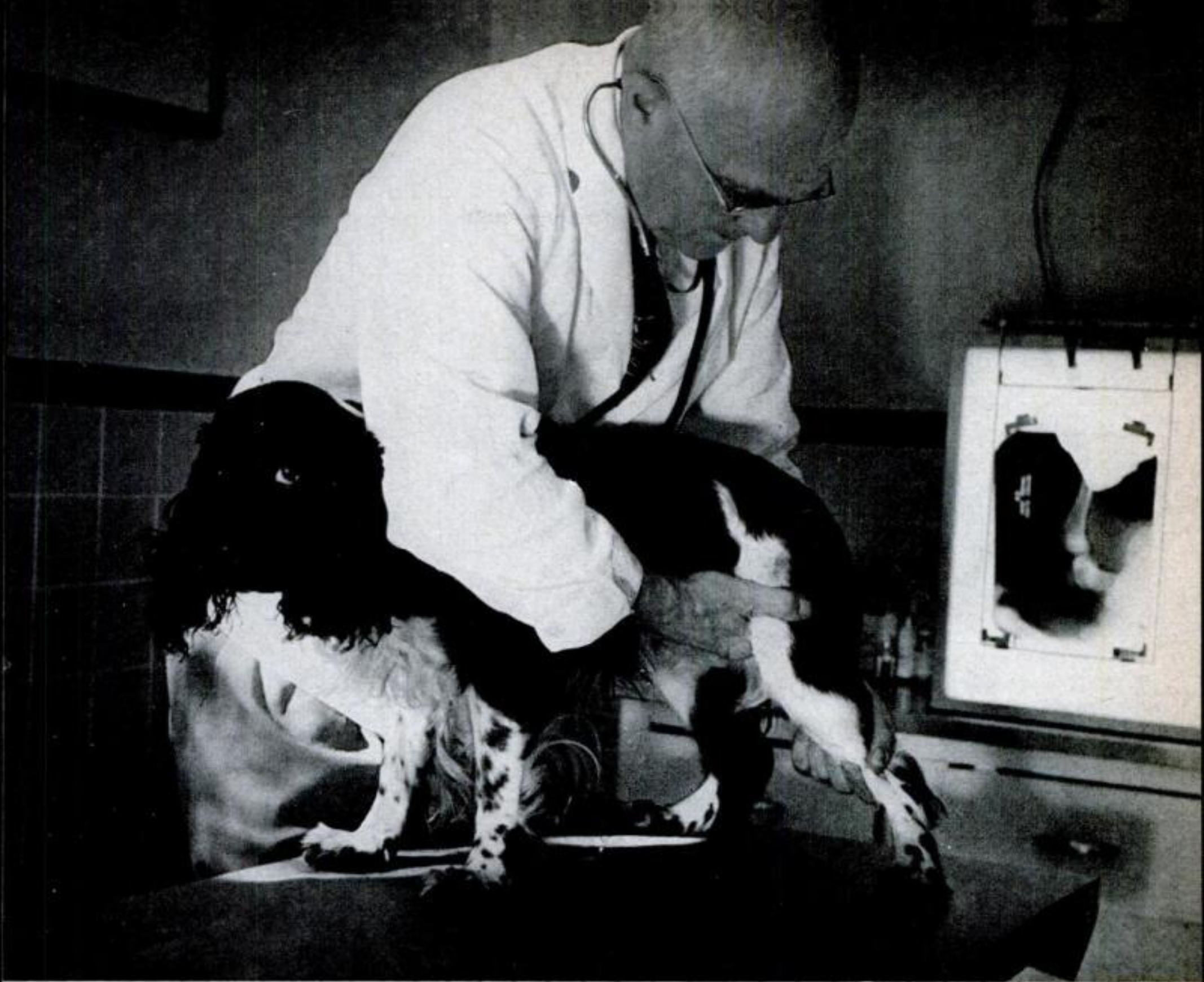


1975: Lunar dust brought to earth

There is an extension of this reconnaissance vehicle that may give scientists a precise idea of lunar surface characteristics. The program involves the use of *two* moon-rockets taking off for the moon, one right after the other. The first rocket, programed to crash on the moon, is armed with an atomic bomb. When the bomb goes off, a tremendous amount of surface material will be blasted high into the lunar sky—higher than on earth, for the gravitational field of the moon is but a sixth of the earth's.

When the lunar dust is highest the second lunar rocket will sweep in from the sky. This rocket is programed to skim down close to the surface of the moon and scoop up material in the dust cloud.

[Continued on page 246]



X-ray diagnosis is now widely used by veterinarians. Here Dr. Whitney checks a healed leg.

What Science Has Done for Your Dog

***A dog's life is a better one
—longer and healthier, too—
thanks to veterinary research***

By Dr. Leon R. Whitney

Author of Complete Book of Dog Care

A FEW decades ago, the average dog lived about three years after weaning. Then some "mysterious" disease struck him down.

Now, in my veterinary hospital in Orange, Conn., it is not unusual to see 19-year-old patients. Teen-age dogs ap-

pear every day. Thanks to modern science, the pup you buy for your toddlers can be expected to grow up with them.

That's a far cry from the experience of my own generation, when most children loved and lost several dogs during the years of their own adolescence. Along with the use of dogs in medical research has come a great advance in the treatment of dog ailments—and a boost in the life expectancy of our canine friends proportionately more than equal to that of our own.

The mysterious disease that killed so

many dogs in past years was called distemper, which simply means illness. Laymen still use the word to describe anything from the sniffles or a hoarse bark to convulsions. But science discovered that distemper might be any of at least 12 different diseases, each with quite different symptoms.

Today, if you take an ailing dog to a veterinarian, he should make tests that enable him to say definitely, "This is infectious hepatitis," or coccidiosis, or just a case of hookworms, as the case may be. He should also be able to save the animal, for only four of the 12 "distemper" diseases are likely to be fatal nowadays.

It shouldn't happen to a dog, for these four killers can be prevented by vaccination. They are leptospirosis, Carre's disease, hardpad disease and, in puppies, infectious hepatitis (not to be confused with the human disease). There is no excuse for letting your dog contract them. Vaccine for the three last-named can be administered simultaneously when a pup is eight weeks old. The leptospirosis vaccination should be done at the age of four months. (Basic research on the vaccine for Carre's disease, incidentally, laid part of the groundwork for that on polio vaccine.)

Antibiotics and sulfa drugs are helpful in treating most of the other distemper-complex diseases. These drugs

were first proved in treating human diseases, so that—to turn the tables—in this instance man served as guinea pig for his best friend.

Gone are the dog days, those summers through which our pets scratched until they bled, bit tail and flanks or rolled yelping in the grass. Fleas or mange made the dog of yesteryear an unhappy beast, and the powders or lotions offered

for treatment of these troubles were both obnoxious and worthless.

If a dog developed "red mange" or sarcoptic mange, most vets in those days destroyed him as a hopeless case. Today the cure of these "incurable" diseases is comparatively simple. Rotenone, which is also an insecticide, is the commonest specific used.

Dogs used to suffer much from fungi and bacterial infections of the skin, for which there was no remedy. Now effective medication for these can be obtained in almost any drug store. Some remedies contain malucidin, a

powerful new antibiotic made from brewers' yeast. It's one of the safest and most potent destroyers of fungi and bacteria yet discovered. Selenium sulfate and cadmium sulfate also are effective when used in the bath.

Fleas are outdated. The new bug killers like chlordane, malathion and peperonal butoxide make it needless for any dog to be flea-ridden. Freeing your pet

Three ways to cure a dog of chasing cars



You may save your pet's life by training him out of the dangerous habit of assaulting auto wheels. Here are three methods that Dr. Whitney advises. You may have to repeat them several times.

1. Ride past in a friend's car. When the dog challenges the car, jump out and switch him.

2. Carry a third of a bucket of water in the car. When the dog attacks the car, throw the water in his face.

3. When the dog gives chase, pull slightly ahead and throw a torpedo firecracker in front of him.

How to pick a puppy and get him off to a good start in life

- Choose your pet from a long-lived breed (cocker spaniel, old-fashioned American fox terrier, collie, or any hound breed) and from a litter born of a long-lived ancestry.

- Have the pup dewormed. Repeat the treatment in 11 days.

- At eight weeks of age, have the pup

vaccinated against Carre's disease, hardpad disease and hepatitis. Repeat the first two at six months' age.

- Get the pup vaccinated against leptospirosis at four months' age.

- Feed the pup two or three times daily until he is full grown at seven or eight

of these pests will also cut down the likelihood of his getting tapeworm, for this is sometimes caused by the swallowing of a flea that has tapeworm cysts in its body.

Ticks are the bane of dogs in the South, and the carriers of Rocky Mountain spotted fever, a killer of dog and man alike. In recent years, ticks have spread northward and could become a national menace, but for the timely development of chemicals that not only kill but repel ticks. In tick-infested areas, dogs should be treated with a powder or spray insecticide of this kind at least once a week.

Science has saved dogs from another old scourge—worms, which used to render them anemic, bleary-eyed, rough of coat, and finally convulsive. All worms were lumped under one diagnosis, and “vermifuge” was prescribed as the remedy. It didn’t work.

Research has since shown that there are several kinds of worms—hook-, round-, whip- and tape-worms, some of which call for different treatment than others. Whipworms, the most damaging infestation, can be eliminated today with a small dose of butylchloride every hour for five hours, with no physic following.

Hookworms and roundworms are treated successfully with the same drug or with tetrachlor-ethylene, a related chemical. So science has brought comfort and longer life to dogs through two common chemicals, originally created for commercial purposes.

Other wonder drugs, from the standpoint of dog care, include heptaldehyde, which sometimes cures breast cancer in dogs. The study of this disease in our animal friends may help us master it in mankind. Science has also produced stilbestrol, a hormone that prevents conception if a bitch is accidentally bred, and so rules out the introduction of an alien strain into a pure breed. Drugs can artificially bring a bitch into heat, making it



THIS HANDSOME BEAGLE, son of a champion, was raised in a wire-bottom pen. Free of parasites and vaccinated against the common dog ailments, he should live 12 or more years.

possible to breed her at a time chosen by the owner.

Perfected modern diets have perhaps done even more for the health and longevity of our dogs than therapeutics. Once it was believed that a dog could not digest fats and starches. Fresh lean meat was considered the ideal food. Today we know that fresh meat is not necessary, and we can feed our pets better at a fraction of the cost of such a diet. Actually, a dog has a better diet than many humans because his food is scientifically selected and, unlike a man, a dog takes what you give him.

Baked and canned dog foods contain all the protein to be found in meat, as well as important vitamins and minerals. They also contain high-calorie fatty acids and precooked cereals, which a dog can easily digest. By feeding your pet inexpensive, dehydrated dog food you can supply all his dietary needs. Keep him from foraging for food and stop him from chasing cars, and you will be able to keep your pet as a faithful companion for many years. END

months. Then feed only once daily, regulating your grown dog's weight by giving him about one-third less than he would eat. Don't give table scraps or tidbits except as training rewards.

- Have periodic examinations made and have the dog dewormed as necessary.

- Use insecticides with residual properties to keep off lice, fleas and ticks.

- Don't let him roam or forage. Spoiled food and wild rabbits are extremely dangerous edibles. Keep him away from mole and rat poisons, newly sprayed weed killers and insecticides.

- Train your pet to obey commands and serve you. Remember that he is a dog, not a human being. He will be happier and so will you.



Army Jeep turns to skyriding. This new "Flying Jeep" will take off and land vertically, fly forward at 150 m.p.h. It is propelled by two rotors—one in front, one behind. It was developed as the 59K VTOL by Piasecki Aircraft Corp. for the Army as a high-utility, general-purpose

Picture News

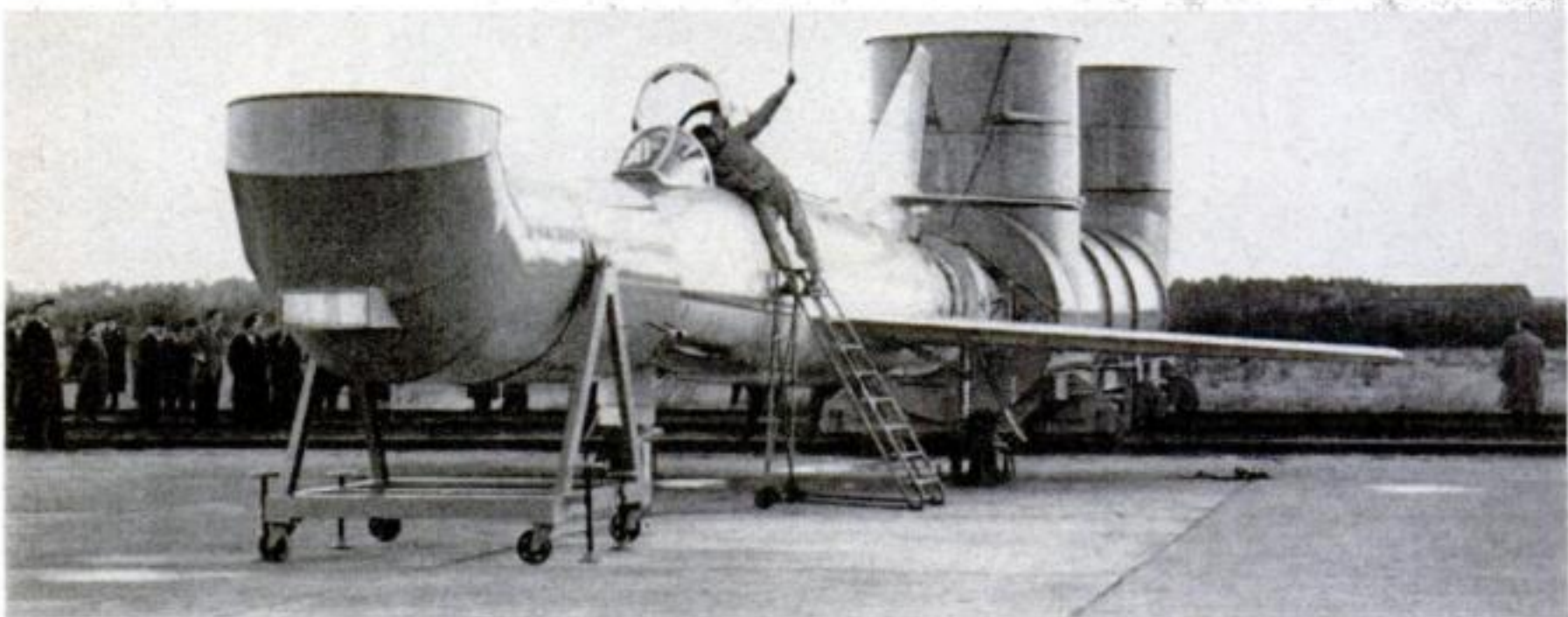
IN THE WORLD OF SCIENCE



vehicle. Designed for extreme low flying, it hugs the ground, will fly under bridges or telegraph wires and behind low objects for concealment. With no wings to interfere, it will go down narrow streets, between buildings and trees. Dual engines, rotors and controls are in its flat body.



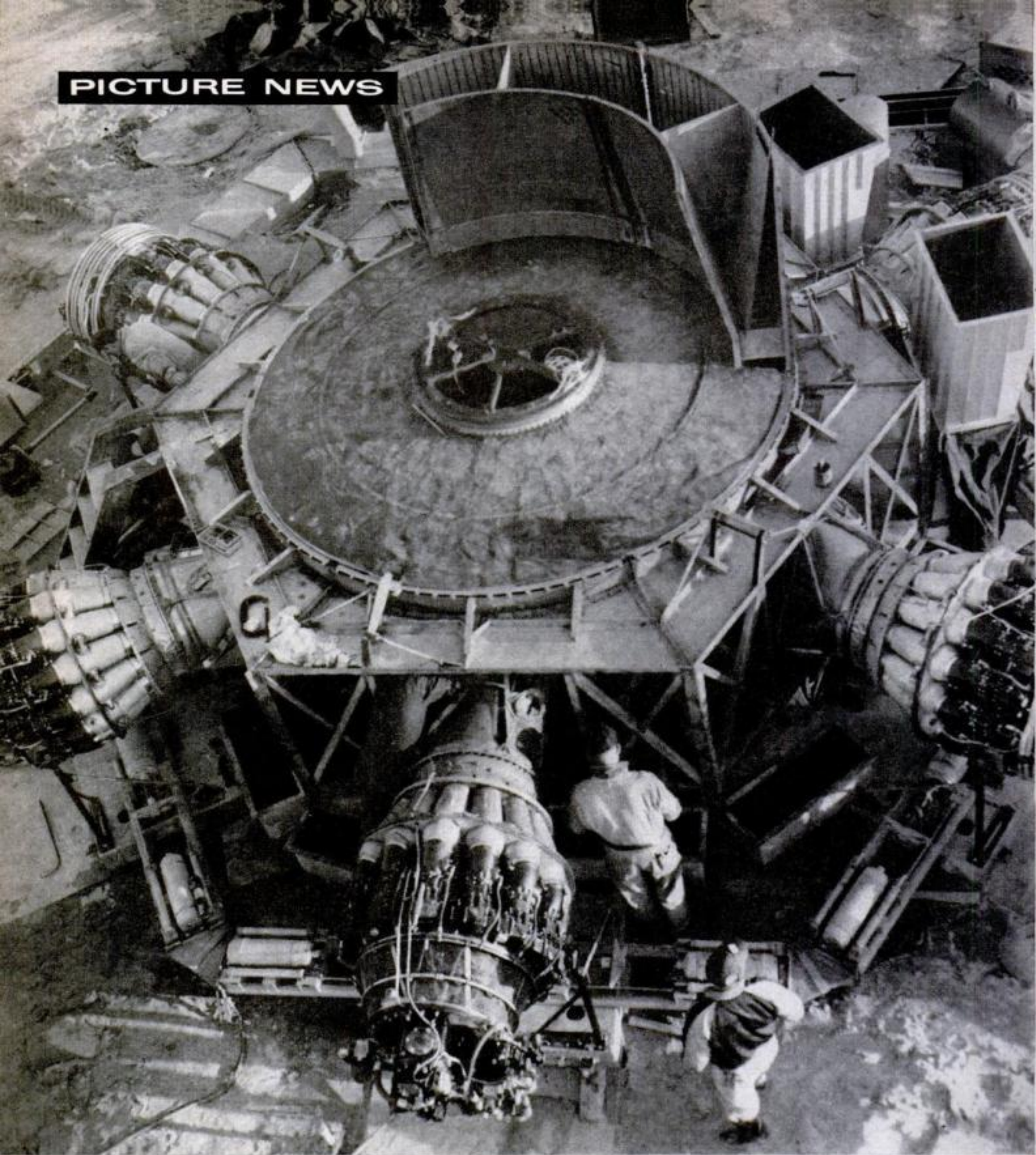
Four-wheel steering. Commercial version of an Army machine (PS, Dec. '57), this tractor can run sideways on four oblique wheels. Steering of the Napco Crab, controlled by knuckle joints, is done with front or back wheels. Front one way, rear the other, it turns in a 12-foot radius.



Nose funnel helps silence jet. By baffling air to the intake as well as from the exhaust, this French Boet silencer reduces noise in ground run-ups of jet engines. Shown in a test on the Super Mystere in this photo from *Aviation Week*, it cut the noise level 37 decibels. The rectangular window at front allows mechanics to align the suppressor.



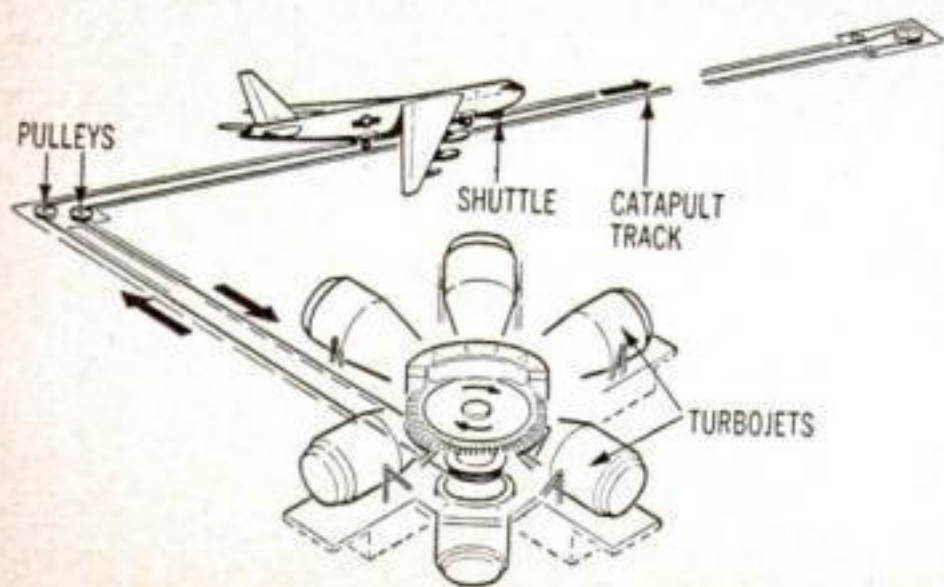
Copter handles big moving job. A helicopter spots a 3,400-pound heating unit here on the roof of Convair's new Atlas missile factory in San Diego. Making 70 quarter-mile trips, it brought 100 tons of heating and ventilating equipment in six hours. Conventional methods would have taken four weeks, required reinforcing the building for rigging.



Jet-powered windmill launches big jets.

This propulsion unit for catapulting heavy jet bombers into the air from short flying fields is under test for proposed Air Force use. All American Engineering Co., the builder, says it will get five B-52s or B-47s and four tanker planes off in 15 minutes.

Heart of the Turbo-Cat: six Allison J33-A16A jets whose exhausts spin a vaned wheel attached to a continuous underground cable riding in slots.



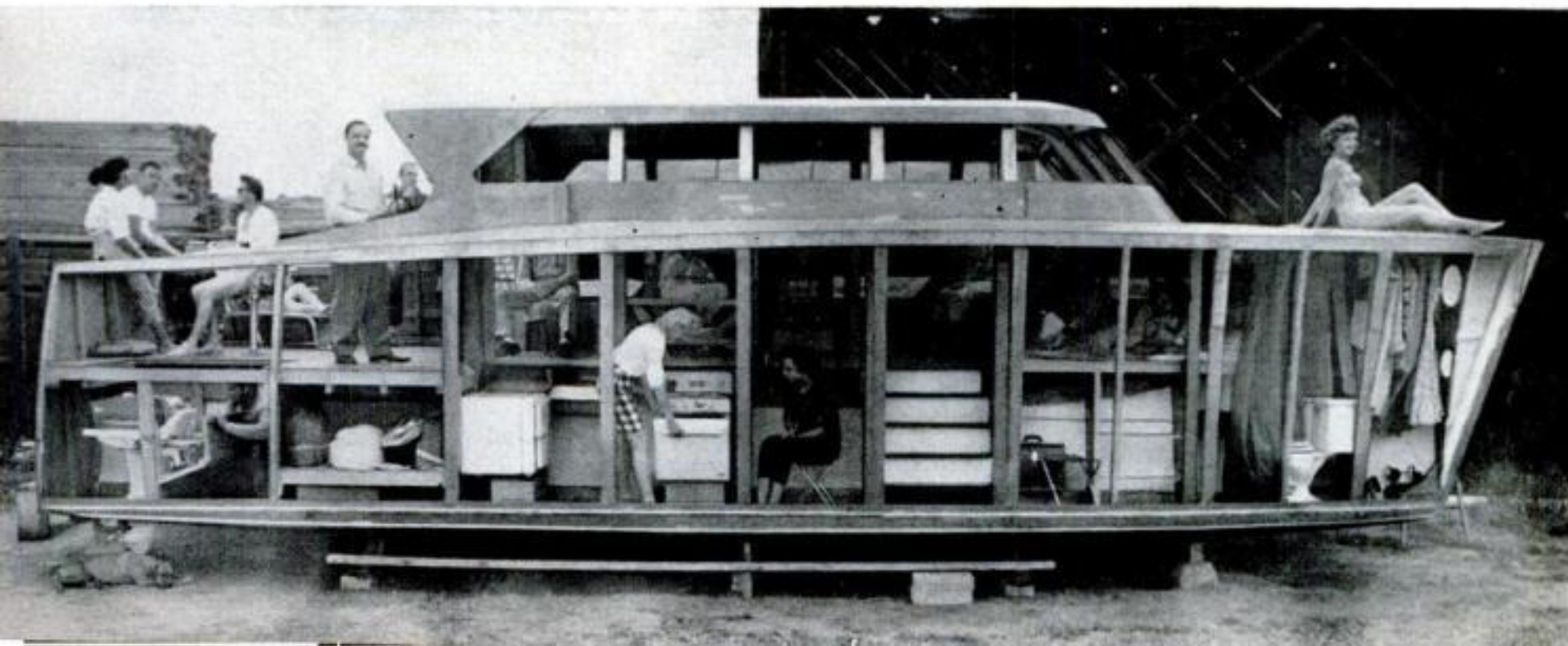


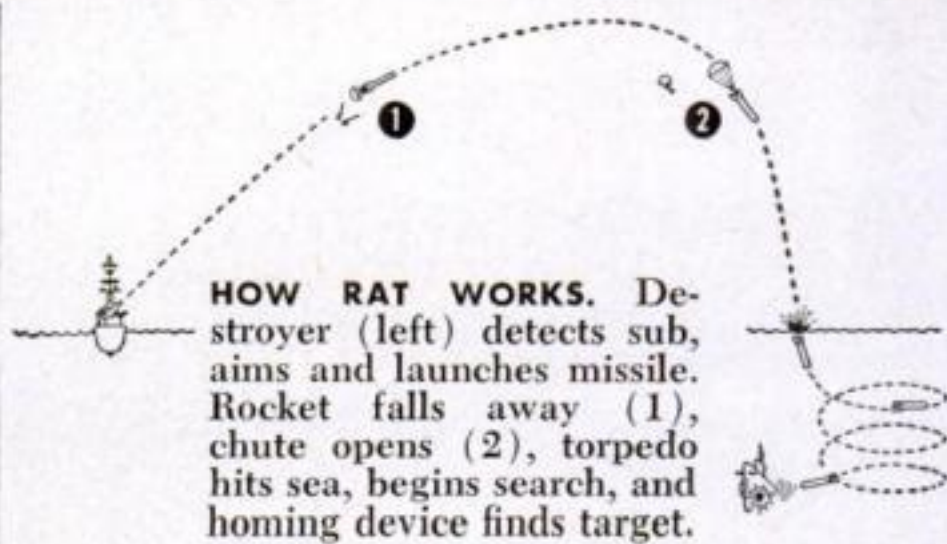
Piggyback trailer. Here is a mobile home that rides on top of its car instead of being pulled along behind it. Designed especially for camping trips, it has full-size adult beds on the lower level, bunks for youngsters on the upper, and room for luggage in the front. It is built in Australia for G. M. Vauxhall pickups, makes parking and reversing a cinch.

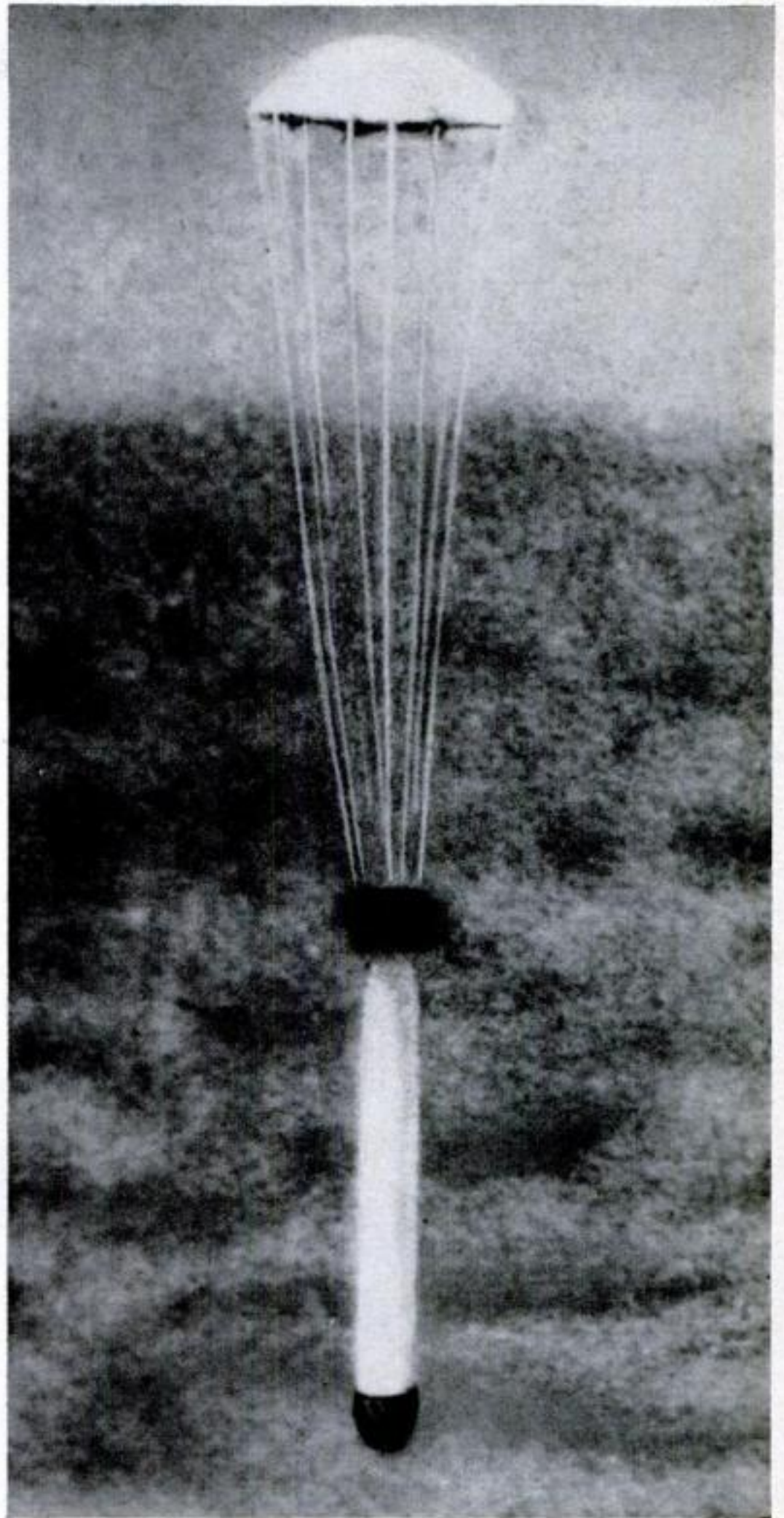
Life inside half a boat. The full-size mockup below of only half a boat was assembled on the beach to show what goes on inside this 35-foot cruiser, one of the largest family outboards afloat.

The catamaran-like Sea Cat-35, shown cruising at right, rides on twin ski bottoms and is powered by two outboard motors aft of the cabin and below the rear sun deck. It has a main lounge, galley, bathing facilities and six to eight berths.

The Sea Cat-35 is made by Custom Hydrocraft of San Diego. It is available in plans, kit, partially built or finished.



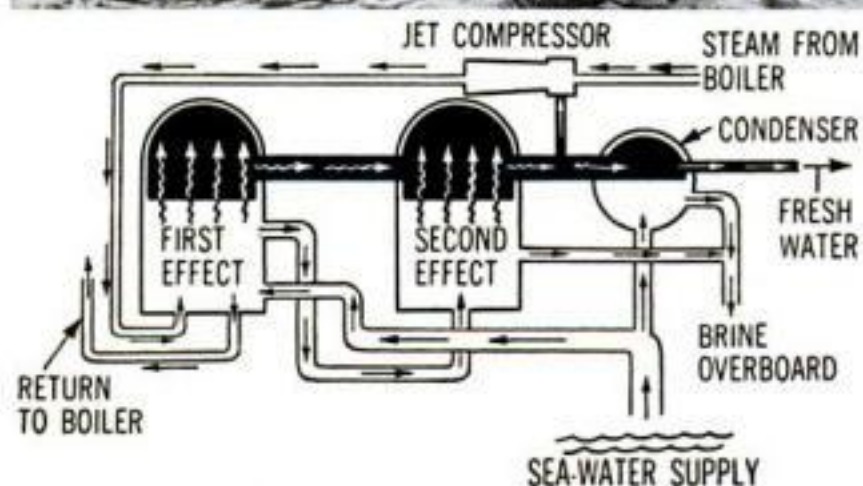
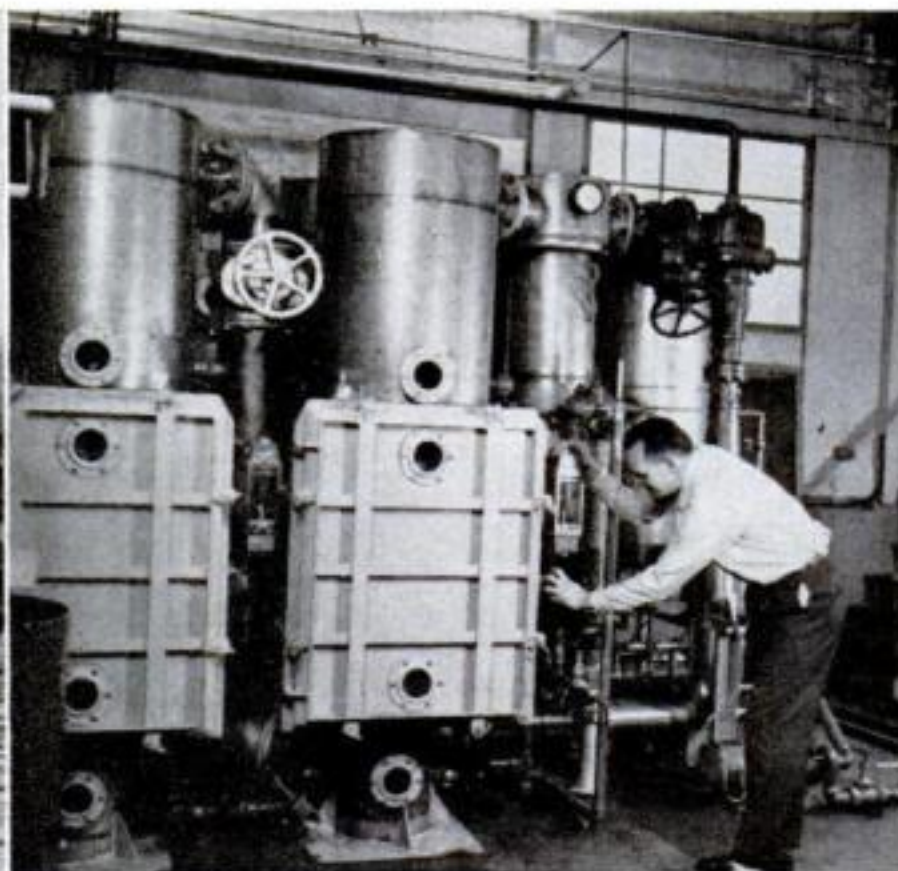




Rocket-propelled torpedo. Here is one of the Navy's newest anti-submarine weapons. It is fired into the air by rocket, drops into the water by parachute and finds its undersea target by use of an ingenious homing device. It extends a destroyer's "kill" area by many miles, enables it to sink a sub while still outside the range of enemy torpedoes. The RAT (rocket-assisted torpedo) is launched from short tracks attached to the outboard edges of a standard five-inch gun mount (lower left) and powered by a solid-propellant rocket engine that falls off near the top of the trajectory. The parachute drops it gently so as not to damage its sensitive mechanism. Rocket and torpedo are 16 feet long, the torpedo eight. The new weapon is already in fleet operational use.

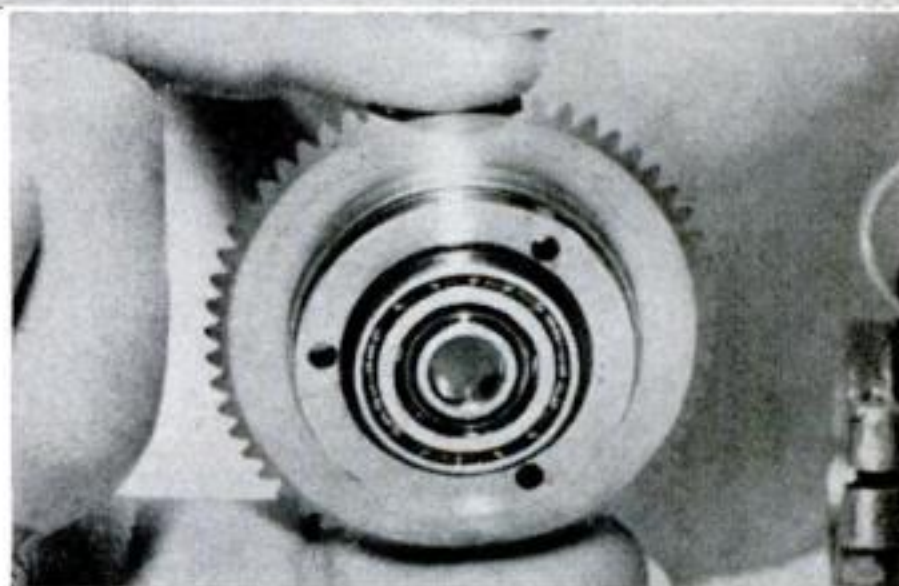
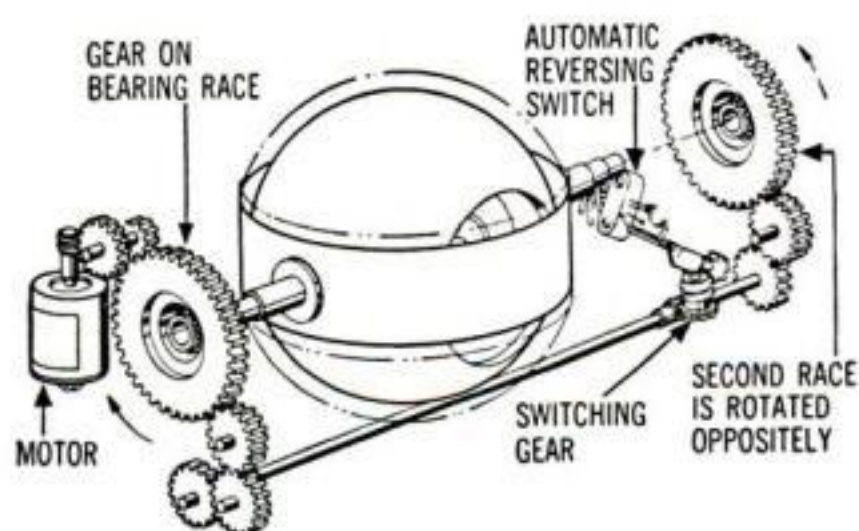
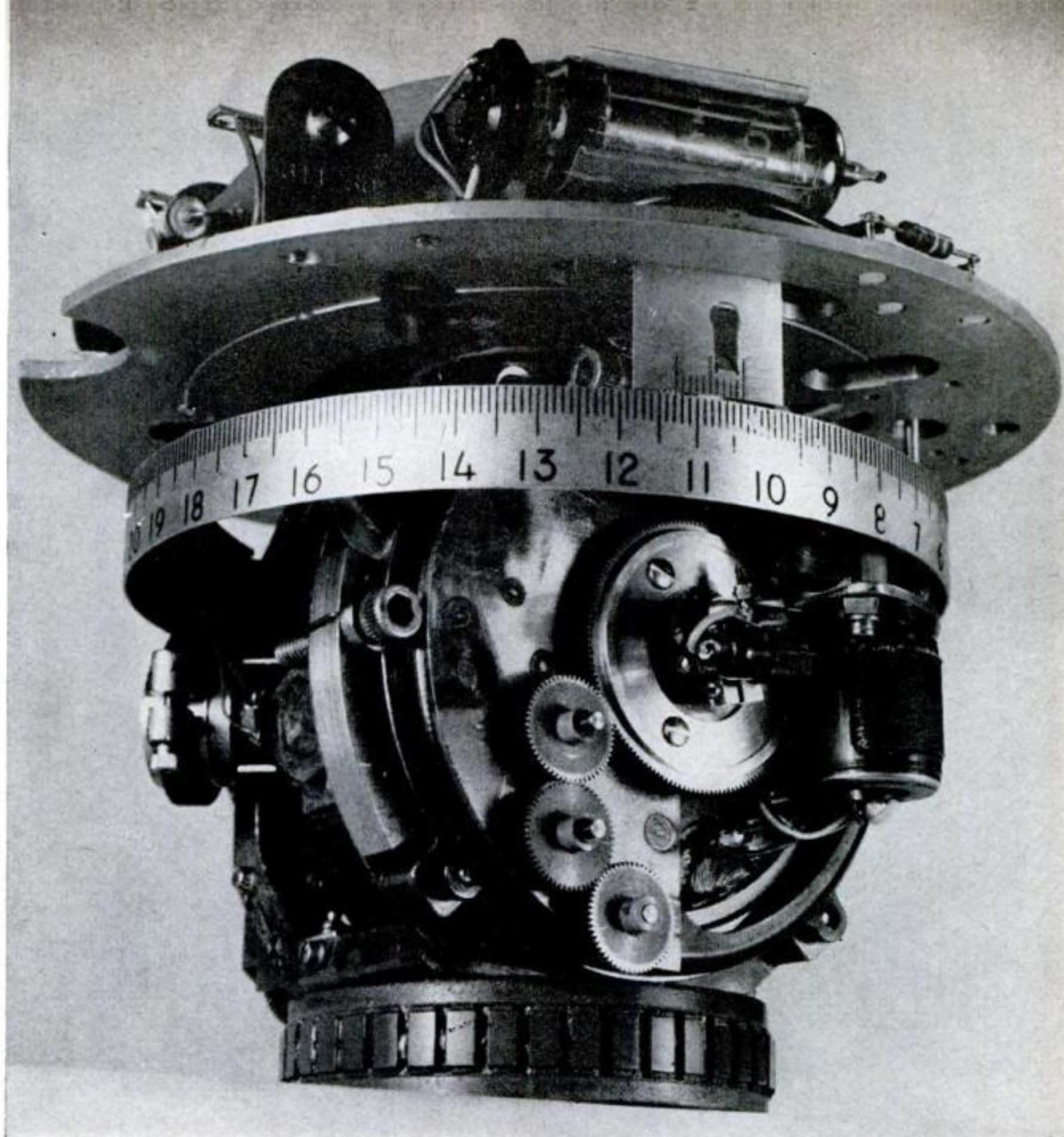


Barbers learn by shaving balloons. One little nick and the balloon heads on these barber chairs go *pow*, spattering barbers and the walls with lather. It's a method of teaching neophytes at Rome's barber school how to handle a razor without danger of cutting the customer.

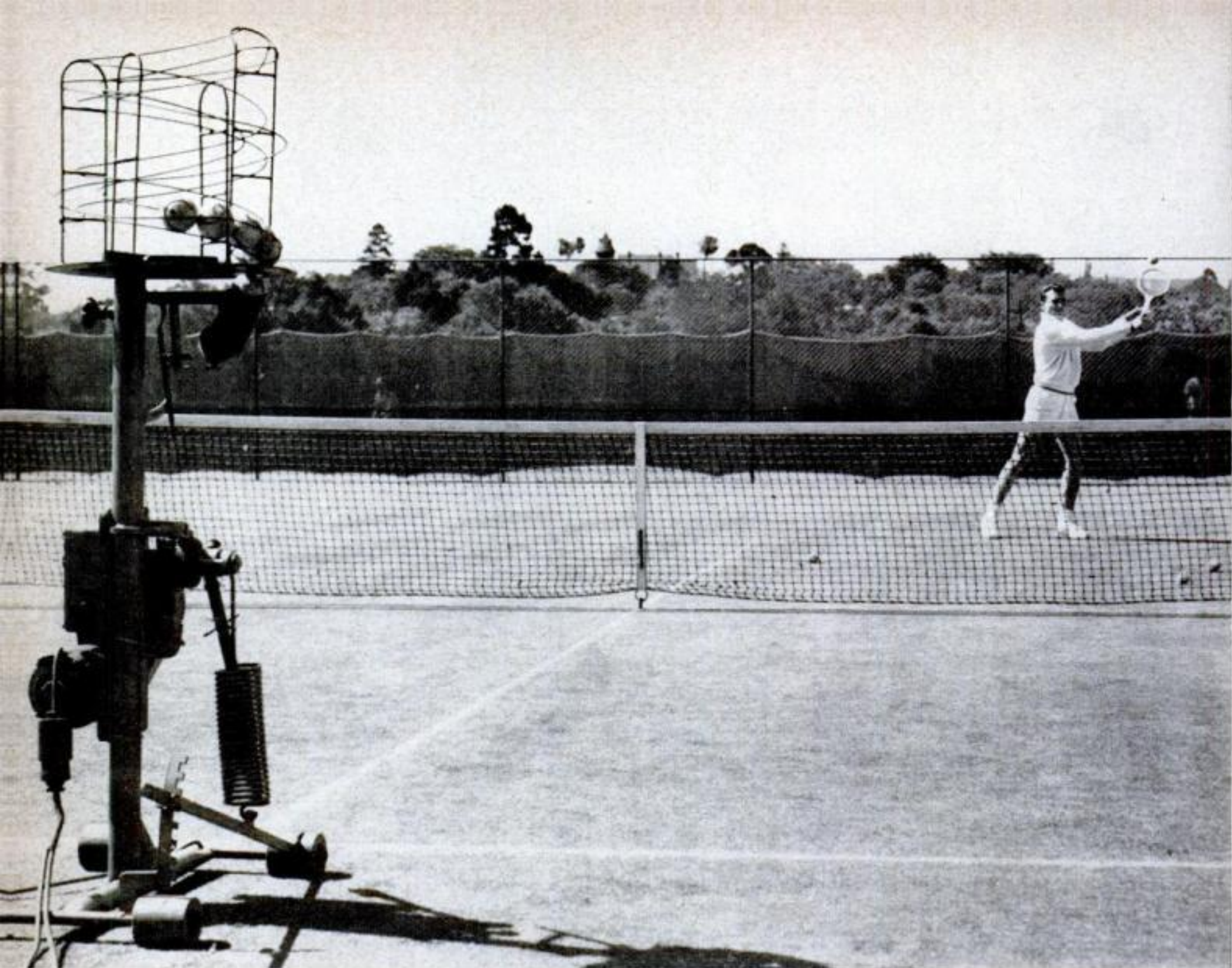


Fresh from salt water. This unusually economical still converts sea water into fresh, at as little as 20 cents per 1,000 gallons depending on local cost of fuel.

It works by evaporating sea water in two flash chambers, then sending the vapor through a condenser. The maker, Maxim Silencer Co., has plants going in Bermuda and the Virgin Islands.



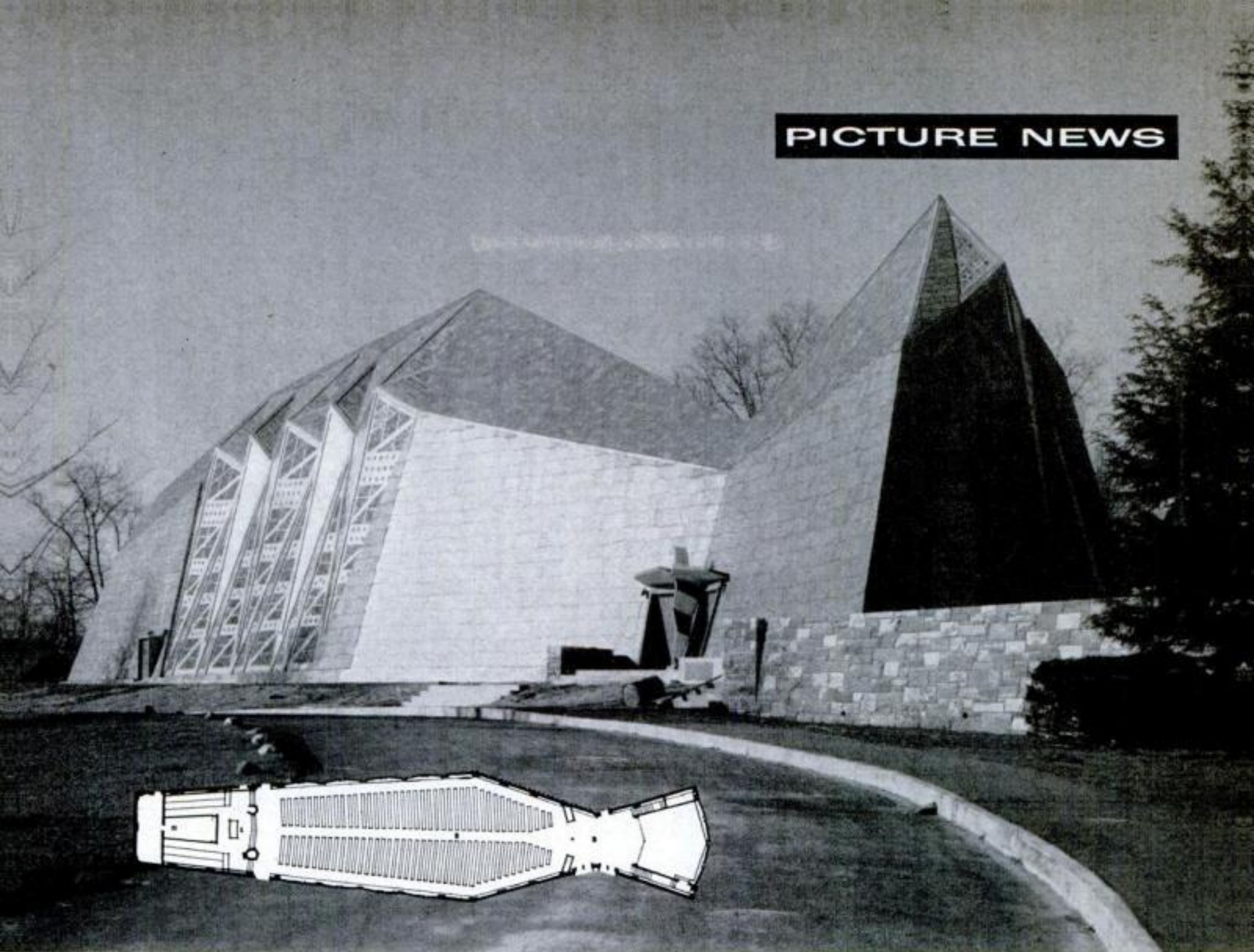
Gear-driven bearings boost gyro accuracy. To cut drift error in gyroscopes due to microscopic bearing faults, Sperry Gyroscope has developed this new gimbal bearing. Called a Rotorace, it is driven by a tiny motor and consists of two races, one running inside the other. The motor revolves the two bearings in opposite directions at about 20 r.p.m. for several turns and then reverses both for a like number of turns. This reduces static (breakaway) friction, averages out wholesale differences between the two bearings and cancels out minute irregularities within them. Drift rates are cut to as little as .05 degree per hour.



Robot serves tennis balls. Firing balls at the rate of 13 to 26 a minute, this machine can duplicate almost every stroke in tennis. It contains four striking heads fitting in a heavy coil-spring striking arm run by a $\frac{1}{4}$ -hp. motor. It was invented by J. R. Black, formerly a well-known Australian player, and is used by schools, coaches and private courts in Australia. Six of the machines are now slamming balls in the U. S.

Rubber boat can't sink. A tough new blend of rubber and plastic makes the 14-foot runabout below virtually unsinkable. The same material, made by U. S. Rubber and called Royalite, is used in automotive parts. In the boats it's a five-ply mold around a honeycomb center. Two boat makers, Crestliner and Wagemaker, plan models for summer.

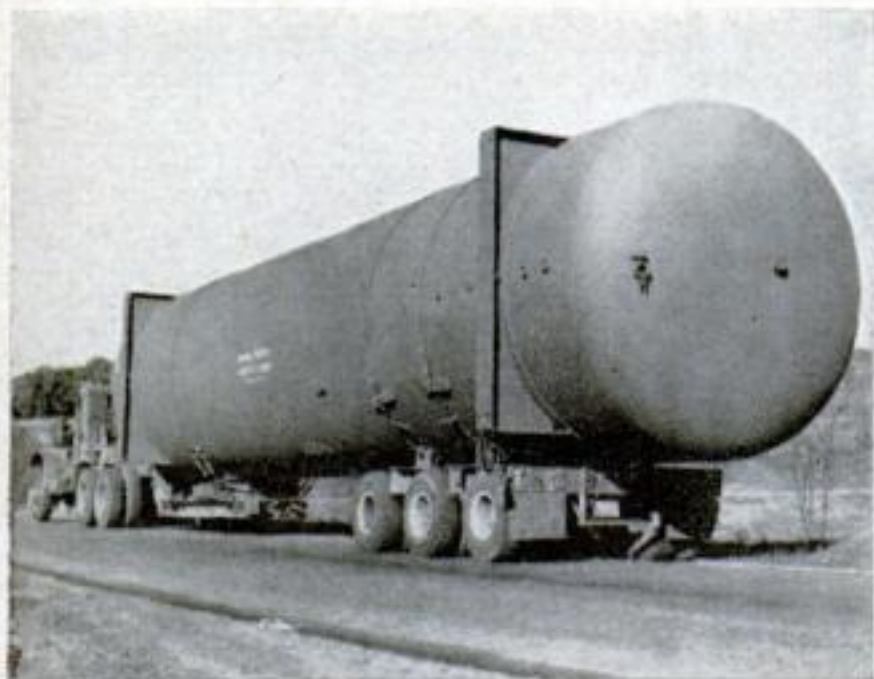




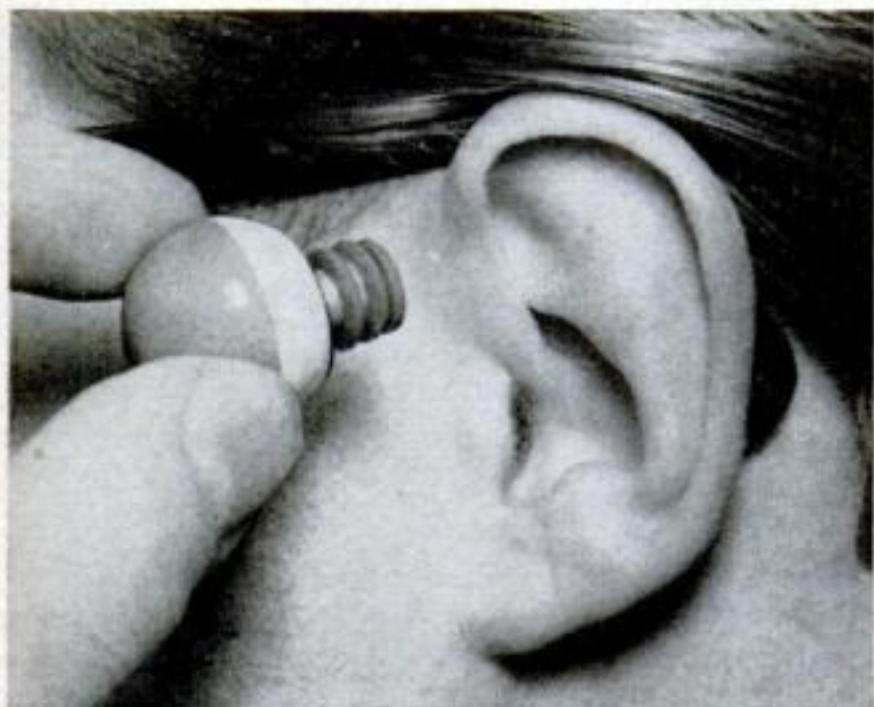
Church designed in shape of fish. Here is a church that is really different. Its exterior lines take the form of a fish, early symbol of Christianity. The recently dedicated edifice is the First Presbyterian Church in Stamford, Conn., built of reinforced panels for a congregation of 800, and includes a parish unit and separate hall for public events. Its architect, Wallace Harrison, planned the United Nations buildings.

Pint-size plane is low in cost. This little plane, named the Topsy Nipper, is only 14 feet long and has a wingspread of 19.6 feet. It is powered by a Volkswagen engine, has a cruising speed of 66 m.p.h. and a maximum range of 187 miles. Built by Fairey of Britain, it sells for \$1,000 in kit form. It's shown beside a Hawker Hunter jet fighter.





Tank is own trailer. When this 30,000-gallon tank was delivered, it was temporarily turned into a vehicle. Steel cables lashed it to a dolly in the rear and to a flatbed trailer at the forward end.



Radio plugs in ear. This tiny portable is carried where it does the most good—right in the listener's ear. A German invention, it uses transistors and a miniature battery, has no connecting wires.



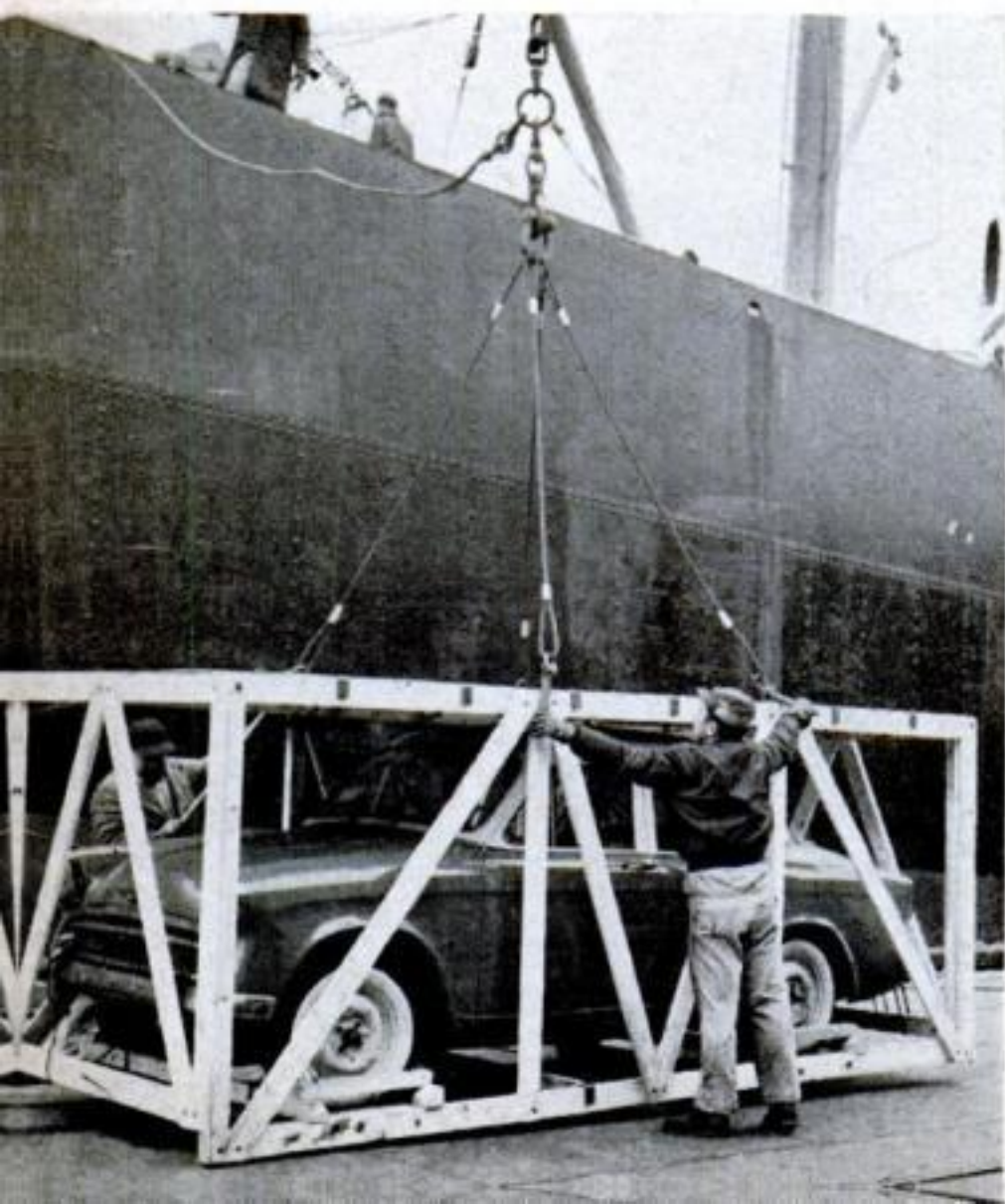
Prisoners' belt. Here's an idea that makes it hard to escape. The sheriff's office in Buffalo, N. Y., put a loop in this belt through which handcuffs slip. It keeps a culprit from using cuffed hands as a club.



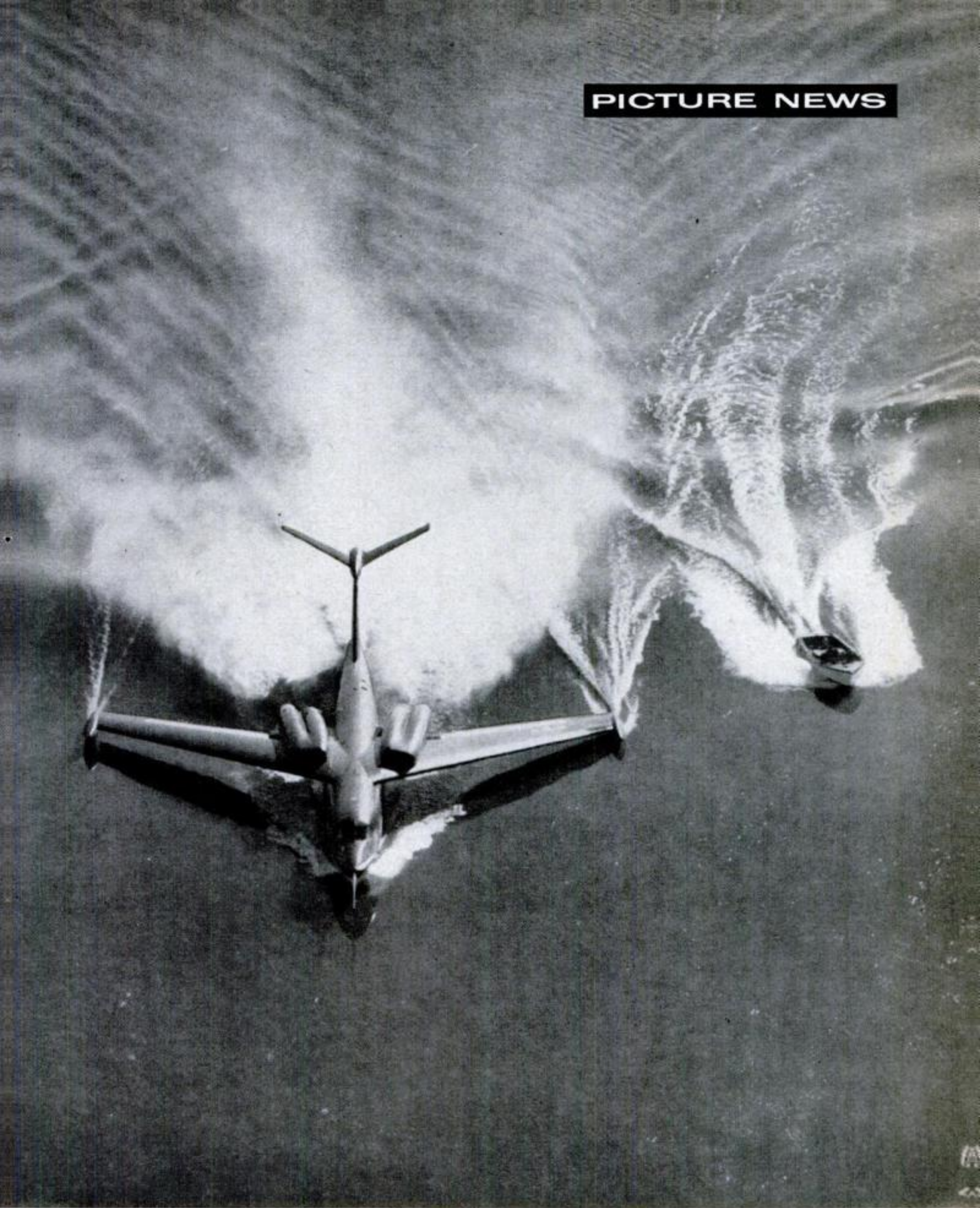
GIs wear paper suits to fight fires. Carrying lightweight hose and piping right to the edge of a fire, these soldiers are protected by the Army's new aluminized kraft-paper fire-fighting garb. Wearing the expendable suits over uniforms, troopers were able to stand within two feet of flames for two to three minutes without discomfort although exposed parts of helmet liners were blistered. They made quick work of the fire.



No-hands phone. Here's a phone you can talk into without taking it off the hook. The box at right is a combination mike and speaker for use by shoppers with arms loaded. Cincinnati is trying it.



Auto crates double cargo. In order to ship more cars in the same space, British makers have come up with the collapsible crate at left. Crated cars are loaded first, uncrated ones go on top.



New SeaMaster is tested. Several changes are seen on this latest version of Martin's XP6M-1 SeaMaster (PS, Nov. '57), shown here escorted by two speedboats as it takes off on its initial successful test flight. Most striking are jet nacelles canted out to eliminate fuselage heating by the afterburner, improved intakes and a changed tail fin. The Navy has ordered 24 of the mine-laying seaplanes, which can drop an A-bomb.

How to Boost Your Score on Any Test

You can't escape tests nowadays. But you can beat them.

Here are the techniques that help you win jobs and promotions

By Darrell Huff

.....

YOU can learn how to score high on tests. And you ought to if you want to get ahead. Because today testmanship, the art of achieving success in examinations, is a key to success.

Why? The psychologists have assumed the responsibility for assigning square pegs to square holes. Tests are their tools.

You have to do well on a test to get almost any decent job with government or big business, and, increasingly, with small businesses as well. A promotion often depends more on a test than on months of hard work—even high up the ladder. Says a General Electric personnel man: "Tests—we use 42 kinds—are given at all levels of employment."

That's not all. You take tests to get a license to drive a car, operate a radio transmitter or repair airplanes. And now the *Journal of the American Medical Association* proposes that retirement be determined not by age but by tests.

It's no wonder that the high school in my town—among many others—has increased the number and duration of its examinations. Not so much to assess the youngsters' learning, explains the principal, "but to give them experience in taking tests."

For test-taking is an art and can be learned like any other. Skilled in testmanship, you can make higher scores.

That goes equally for the two kinds of tests you'll face:

- Information tests, which try to find out how much you know.
- Aptitude tests, which try to find out

how good you will be at something or other.

Get ready emotionally. You'll do better if you regard each test as a *contest*. The sporting, let's-see-who'll-win attitude—not grim determination or passive compliance—produces results.

The reason: Tests are battles of wits between you and the other fellow. Somebody wants information about you. You, on the other hand, have no interest in giving information. What you want to do is make the best possible case for yourself, just as you would during a job interview.

So tackle a test by first asking yourself what answer the tester wants—then giving it to him. Most people handicap themselves by trying to give "right" answers instead of wanted answers. These are usually the same, but not always. That's because no test is perfect, some are far from it, and many good ones are misused.

According to testimony before the Congressional committee on atomic energy, "Boss" Kettering of General Motors once gave the MIT entrance exam to 57 of his top engineers. Exactly 53 of them flunked.

Or take the case of the plant that needed people to assemble parts so tiny that they had to be held eight inches from the eyes. This obviously called for excellent eyesight. So the standard visual-acuity test, which checks vision at 20 feet, was used. Only after considerable damage had been done was it discovered that this test was turning away the qualified applicants and hiring the unqualified ones.

Can you outfox
the T-men's
picture test?



GAUGE YOUR POWERS OF OBSERVATION with this picture, used in testing would-be Federal operatives. Study it for five minutes, then try

to answer the questions on page 238. (The rules of testmanship will help, even if you're the type who barely notices his wife's new hat.)

The job, it turned out, was best done by nearsighted people—who flunk 20-foot tests but see exceptionally well at eight inches.

The vogue for intelligence tests has led companies to hire by IQ scores. One business found itself with the industry's brightest sales staff—and poorest sales.

So maintain a healthy doubt about how much sense the test makes. Combine this with a sporting, competitive attack and you'll be in emotional shape for a test.

Get ready mentally. If it's an information test, review if you have time. Cram if you don't.

Cramming is not the ideal way to learn anything and retain it. However, when you must learn something of minor importance and retain it just long enough to pull through an exam—then cramming can work wonders.

Review or cram actively. Use pencil and paper. Outline your material. Stop frequently to lean back, close your eyes and visualize. Underline each point in the book that you would use if you were constructing a test.

Actually, you can anticipate what will be used.

It's simple. Study previous tests. Usually you can get whole exams or sample questions simply by asking. (For a set of "Specimen Questions from U. S. Civil Service Examinations"—some are shown on these pages—send 25¢ to the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.)

Notes of likely test items can be fixed

inside your head even minutes before T-hour by super-cramming.

That's how a young man recently landed a semi-engineering job he would otherwise have missed. He knew he would come up against trigonometry problems. But he had never been able to memorize the formulas involved.

He wrote the formulas on a file card. For days he carried the card wherever he went, studying it on the bus, at breakfast, before going to bed. And he carried it right up to the door of the examination room and stood there running his eyes over it. Then he tore the card in two, dropped the pieces and went inside. Without glancing at the exam questions, he immediately wrote the formulas—before they could vanish from his fleeting memory—along the margin of the sheet. From then on he referred to them as he needed them. He placed second in a group of more than 100.

Preparing for an aptitude test. First brush aside all official advice. You will be told that these tests seek out inner aptitudes which studying and learning will not change. Supposedly, you *can't* study for them.

That's nonsense, and dangerous nonsense if a job is at stake.

Truth is, the makers of the tests have not been able to eliminate the effects of learning, hard though they have tried. To the extent of their failure, you can boost your score by cramming.

But choose review material with care.

It is effective to prepare for a test of

Quiz samples let you polish up your testmanship

1. As a driver brought his truck into a long curve to the left at 40 m.p.h., he made a moderate application of his air brakes, and at that point he felt a pull to the right on the steering wheel. Which one of the following could not have caused that pull?

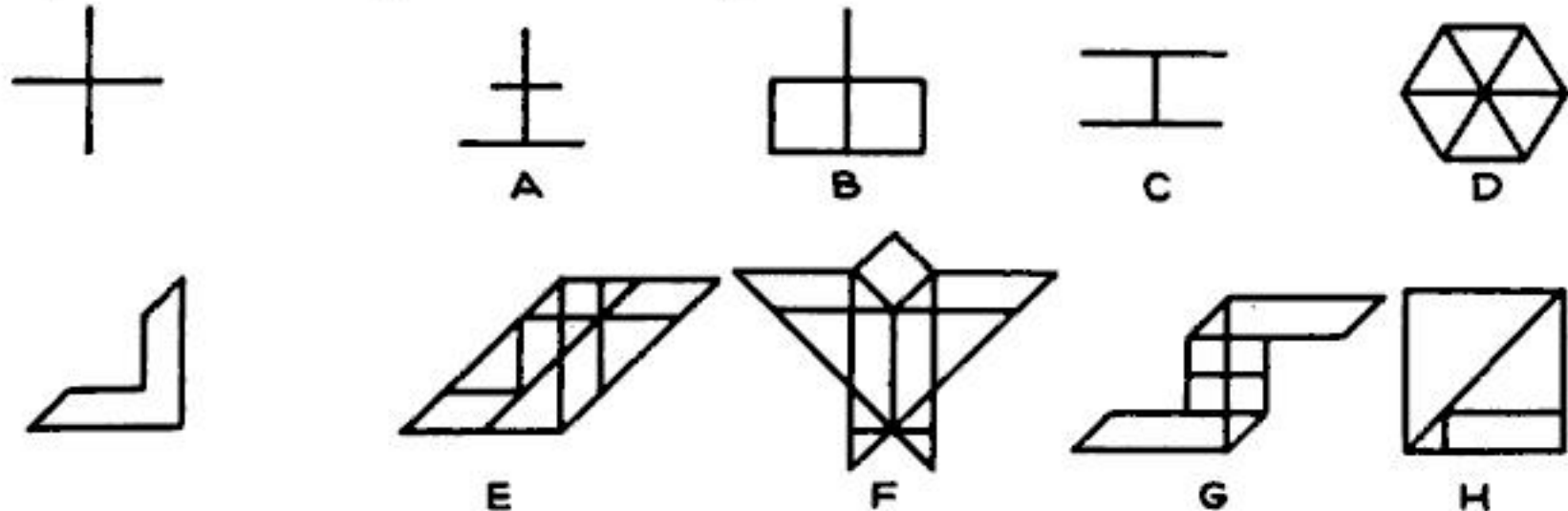
- A) sudden air loss in right front tire
- B) lack of super-elevation on curve
- C) lack of adequate tread on front tires
- D) unbalanced adjustment of brakes

2. In experiments on the localization of sound in space, the sounds which can be most accurately located by the hearer are those sounds originating at points

- A) in the plane equidistant from the two ears of the hearer
- B) in front of the hearer
- C) above and below the hearer
- D) to the hearer's left and right
- E) behind the hearer

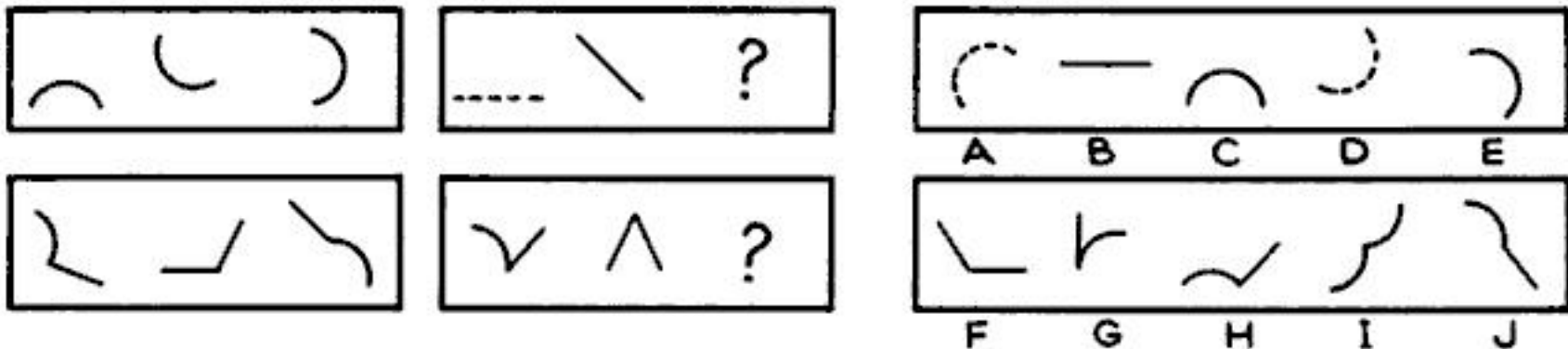
3. Look at the rows of drawings below. In each row, the design at the left is contained in one or more of the more complex drawings. A drawing is to be marked as an answer if it contains the exact design in the same position. The designs in the drawings

need not be aligned with the original design, but they are not to be turned. The designs and drawings are two-dimensional. If more than one drawing contains the exact design in the correct position, mark more than one answer.



4. Each of the two groups below has two boxes at the left. The first box has three symbols, and the second box has two symbols with one missing symbol represented by a question mark. There is always some difference between the symbols in the first box

and the symbols in the second box. You are to decide what the difference between the symbols in the first box and the symbols in the second box is, and choose one of the symbols in the third box which can best take the place of the missing symbol in the second box.



5. There are five drawings lettered A, B, C, D and E. Four of the drawings are alike in

every way. Find the one that differs from the rest.



Answers: 1-C; 2-D; 3-B, E & G; 4-B, C; 5-B.

mechanical aptitude by studying the laws of mechanics.

But for a language-aptitude test, don't waste time with French vocabulary or Italian idiom. Concentrate on principles of grammar and language structure.

For an aptitude test, unlike one on information, the basics of the subject are more useful than the details.

IQ tests are the hardest to cram for. Increasing your vocabulary by learning many new words may help. But the most effective preparation is practice on intelligence tests. Even test-makers concede that you can lift your IQ five points by practice. So study. It will pay off.

What kind of answers will be expected of you—short or long? Aptitude tests are usually "objective," involving short, right or wrong answers. Information tests may be that kind, too, or they may require long written essays for answers. Again, you use different approaches to suit the different types.

Consider long-answer exams. The most important rule: Make sure you're doing the right thing. Read *all* directions carefully. A lot of the people sitting around you will eliminate themselves just by overlooking or misreading instructions. And check that you have a complete, legible copy of the test.

Now apportion your time, but allow minutes for a read-through first and a review last. If you have an hour for 10 questions, allow five minutes for each.

Many examinations say something like "Answer five of the seven questions." Make your choices now, eliminating those you don't plan to answer before wasting any time on them.

Then answer easy questions first. Use your time to get full credit for good answers to easy ones, instead of wasting time doing badly on hard ones. Psychologists have also found that you will do better on the hard questions if you save them for last. Your subconscious mind mulls them over while your conscious mind bats out answers to the easy ones.

If you do misjudge time, here are two situation-savers:

- 1. Outline an answer. Notes indicating complete knowledge of the subject will garner far more credit than formal coverage of a single point.

- 2. Save words by using cross-references: "Efficiency of aircraft engines is

also reduced by factors mentioned in Answer 3 and first two paragraphs of Answer 4 above."

Simple writing devices upgrade your answers, especially—let's admit it—when you don't know as much as you might wish about the subject. Keep sentences and paragraphs short. Make diagrams, rough graphs, outlines of points. Underline important sections. Illustrate your points: "The main span of the Golden Gate Bridge, for example, is suspended..."

Use technical terms when you can. They save words—and time—and show your grasp of the subject. Properly used, they can hide your ignorance of some details. But beware. Improperly used, they give you away, dead.

Should you bluff? The poker rule applies: Don't bluff with nothing.

But don't give up unless you are sure that what you have *is* nothing. Asked to evaluate a point of view, you usually can restate it in several forms. Knowing only part of the answer, use what you know. The perfectionist, unwilling to do anything unless he can do it just right, often takes an undeserved beating.

Above all, play the prejudices of the examiner in such matters as humor, arguing, slang, handwriting tricks and over-used gambits. You can guess most of his prejudices. These rules will keep you out of unnecessary trouble:

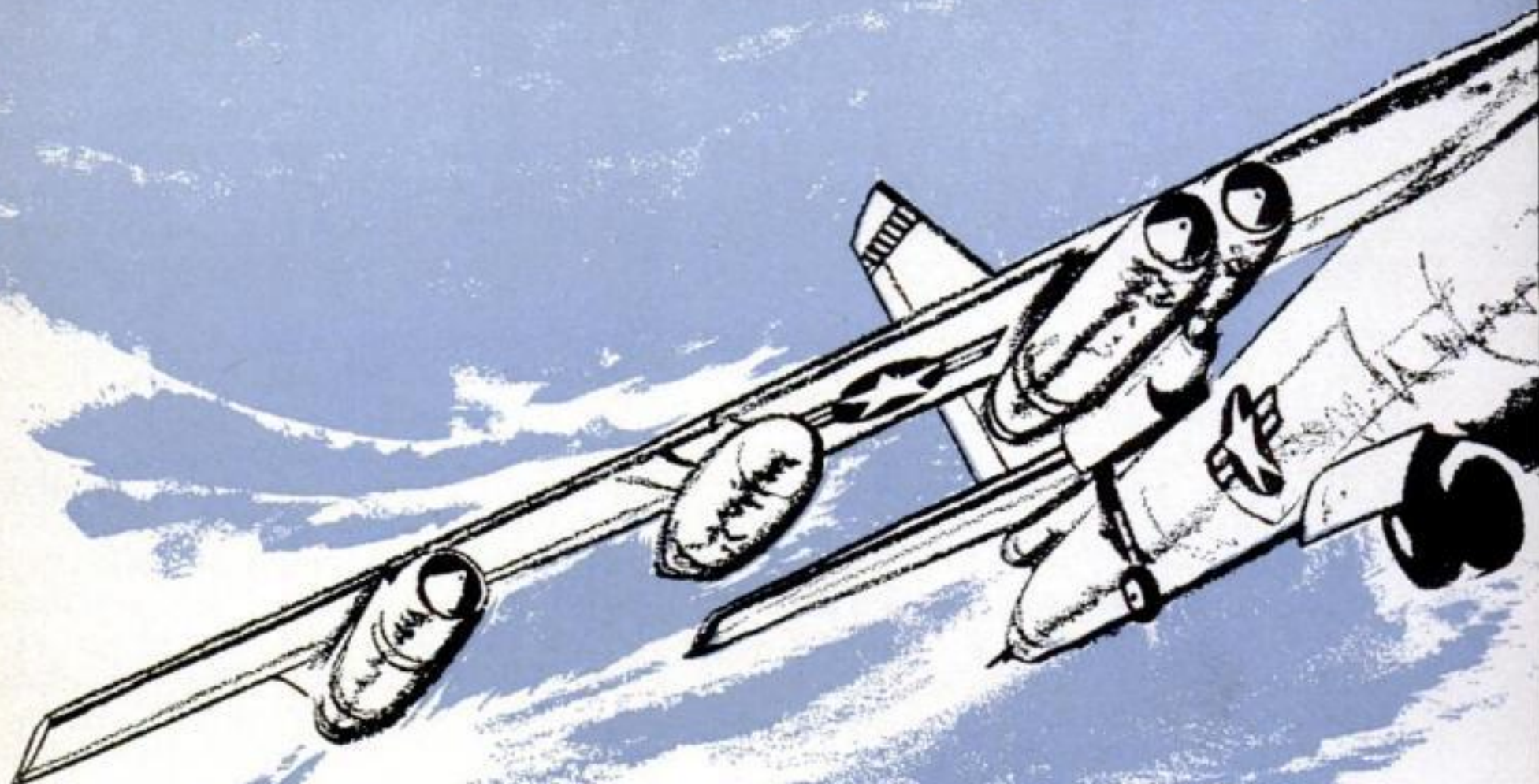
- Avoid humor unless it comes naturally and easily.
- Don't argue with the questions, no matter how bad they are.
- Go easy with slang. It won't help and it may hurt.
- Be conservative about punctuation, spelling and grammar, even if the test has nothing to do with English composition.
- Write legibly and simply—no doodling, no trick letters.

As for short-answer exams, these "objective" tests are the most widely used today because they are cheap and easy to give and to score. A single test organization administered 850,000 of them in one recent year.

Objective tests of both aptitude and knowledge are used to sift college students and scholarship applicants, Army and Navy personnel and officer candidates, job applicants, workers ripe for promotion, med students and surgeons.

[Continued on page 234]

The B-47 That Couldn't Come Down



The B-47 is at present one of our most important deterrents to aggression. Although classed as a medium bomber, it can deliver in a single drop more explosive power than was fired by all the armed forces during all of World War II. Each B-47 costs \$2,500,000.

So the professional pilots of the Strategic Air Command hate to lose one. Sometimes the men of SAC go beyond the call of duty to save one of their aircraft—especially a familiar one that has served them well on missions all over the world. This is the story of the long night in which a brave crew fought to save a B-47 from destruction.



THESE ARE THE MEN who shared a nerve-shattering experience on a "routine" flight. From left: Lt. Joe Fearn, copilot; Capt. Ed Wieland, bombardier; Capt. Bob Dupras, pilot.

By Eliot Tozer

AT 5:32 on the afternoon of Sept. 4, 1957, Capt. Robert W. Dupras swung his bulletlike B-47 into the landing pattern at Little Rock Air Force Base and reached for the lever that would lower his big bomber's forward main landing gear.

He was completing a routine local mission. There was no inkling of what was to happen; he was thinking that it would be good to get home to Edythe and the three kids at a reasonable hour for a change. With a practiced eye, Dupras checked the



Capt. Dupras hauled back on the yoke and the B-47 groaned and clawed for the dark sky. She gained 9,000 feet before he could level her off

green-glowing dials of his instruments. Each needle hovered in its proper place.

Capt. Robert Dupras, with 2,800 flying hours, 1,300 of them in the B-47, is a "lead" aircraft commander. That means he'll get one of the choicest targets if the Pentagon ever hits the button. After World War II service as a navigator he had returned home to civilian life in Glacier Park, Mont., but had come back to the Air Force in 1948.

About five feet behind Dupras sat Lt. Joe Fearn, copilot, a quiet-spoken red-head from Coolidge, Kan. Fearn moves slowly and says little. He's a good counterbalance to the lean, high-strung Bob Dupras. Like Dupras, he lives off the base except when the crew is on 72-hour alert, long periods of absence his young daughter Karen can never understand.

Deep in the nose of the B-47, cut off from the world except for three small windows and a tiny passageway back to Dupras' cockpit, sat Capt. Edward Wieland, bombardier. A native of Minneapolis, Ed Wieland is short, stocky and fast. If there's anything to laugh at in any situation, Ed Wieland spots it first.

Bob Dupras was halfway through his landing checklist when he saw trouble, quiet but chilling. His forward main landing gear had not dropped into place. He snapped down the landing-gear lever again. Nothing happened. A quiver of

tension stiffened him, and he hit his mike button. "We've got some trouble up here," he said to the tower. "Request permission to leave the landing pattern."

He poured the coal to his Stratojet's six powerful J-47 engines and climbed out to 16,000 feet, where a jet bomber in trouble belongs.

6:00 PM

The B-47 has two sets of main landing gear, forward and aft, and two smaller outboard wheels. Normally, the pilot lowers the gear with the electrical system. In an emergency, he can force it down with the ELGE (Emergency Landing Gear Extension), a hand-operated mechanical system.

Dupras called Fearn. "Joe, get down on that ELGE handle, will you? Forward main is jammed in the UP position. And make it fast. We're running pretty low on fuel."

Joe Fearn scrambled down off his high perch behind Dupras and wedged himself into the crawlway to the left of his seat. He heaved on the ELGE handle again and again. It would not budge. He crawled back to his seat, breathing hard. He had fought with the handle without oxygen. "No go," he said.

Dupras studied his fuel-flow meters, then radioed to Bow Legs Control at Little Rock.

"We can't get our landing gear down," he said tightly, "and I'm running out of fuel."

Minutes later, Bow Legs called back, "We've got a tanker for you, Five Nine, from Barksdale. Rendezvous over Texarkana at 6:50 p.m."



6:50 PM

Bob Dupras wheeled his big bomber onto the specified heading of 360 degrees over Texarkana and flicked on his electronic rendezvous gear. He was hungry and tired. He drummed the top of the steering yoke as he waited for the rendezvous gear to warm up. Its radar would help him find the

Dupras brushed the jettison button and the world exploded

tanker in the growing darkness. Then he saw with despair that the rendezvous gear wasn't working.

He scanned the sky tensely. He had less than 30 minutes of fuel remaining—just enough to make one pass at Barksdale AFB at Shreveport, and if that failed, pull up and bail out.

Then he found it, a KC-97 from the 376th Air Refueling Squadron at Barksdale. The tanker had just helped support a big mission from Second Air Force, so it had little spare fuel aboard. But it had set a record in getting airborne in 18 minutes after the call for help from Little Rock. Normally it takes two hours to pre-flight and launch a tanker.

When Capt. Dupras finally broke away from the KC-97, the sun was well down behind the Ouachita Mountains and Little Rock AFB was wrapped in shadow. His fuel problem, though not solved, was put for the moment in the background of Dupras' mind.



7:40 PM Now there was a new voice from Bow Legs Control. Lt. Col. Arthur W. Kenyon, ranking officer of the 544th's Standardization Board, had climbed into the tower. So, too, had three other ranking officers, one a general. With the four regular tower operators standing by, Col. Kenyon took over.

"Five Nine, the Boeing people at Wichita called seven of their engineers back to the factory to sit in on a round-robin telephone hookup with us. They may have some ideas that'll help. Can you stand by until we get it set up?"

Dupras, tooling his B-47 in wide circles around the familiar lights of Little Rock Air Force Base, replied, "I've only got about one hour of fuel, Colonel."

"Okay, Five Nine, we'll set up another

tanker to rendezvous with you at 8:30."

Another tanker, thought Dupras. Another hookup without rendezvous gear, this one in total darkness. "Roger," he said wearily.

10:00 PM Bob Dupras knew that fighter pilots sometimes snap down jammed landing gear by nosing over into a dive and pulling up sharply. The centrifugal force at the bottom of the pull-out jerks the gear down. The B-47 is no fighter. It's a clean-lined heavyweight that builds up speed quickly. Fully loaded, it grosses 200,000 pounds. If its wings are subjected to forces much greater than three Gs, they can buckle or snap off.

Dupras pressed his mike button. "I'm going to try a pull-up," he said. "I'll try to hold it down to two Gs." He paused. "If we get into trouble, you blow the canopy, Joe, and go first. I'll bail out right behind you."

"Roger," said Fearn.

"Are you ready, Ed?"

"We're always ready down here," cracked Wieland.

Gently, Bob Dupras nosed the B-47 downward, his eyes riveted to the air-speed indicator. 350 knots . . . 375 . . . 400 . . . Now! He hauled back on the yoke and the B-47 groaned and clawed for the dark sky. She gained 9,000 feet before Dupras could level her off.

But the landing-gear position indicator did not move.

1:30 AM With the Boeing engineers calling the signals by telephone and radio, Dupras had tried a dozen fixes—with no luck. As he swung southwest to rendezvous with his third tanker, he felt that time was running out. Even the engineers seemed to be grasping at straws.

4:30 AM Carefully Joe Fearn chopped a hole in the aft bulkhead so he could watch the landing-gear cables while Ed Wieland heaved on the ELGE handle. He made each stroke with deliberate caution so he would not slash an electrical cable or a hydraulic line. Then, while Wieland hauled on the handle, Fearn watched the wheels. They

. . . The cockpit filled with dust as the B-47 pitched forward

trembled in place but they did not go down.

On the way back to his station, Wieland straightened up beside Dupras. "Joe's out of cigarettes," he said. "And we're almost out of drinking water." They both smiled.

Wieland rubbed his belly ruefully. "Man, I'm hungry," he said. "When are you going to land this thing, Bob?"

5:30 AM

Wearily Dupras thought back over the nightmare of the past 14 hours. He had tried everything but the most drastic fix of all. He still didn't feel easy about it, but he said on the intercom, "I'm going to shut down the entire electrical system. If a solenoid is jammed, that'll disengage it and Joe can force the gear down with the ELGE."

Fearno and Wieland stiffened in their seats. With electricity off, the B-47 would lose all her lights, radios, fuel-flow meters, rudder and elevator boost, and gyro instruments. She would be a dark, blind, almost helpless airplane.

"What if the power doesn't come back on?" asked Fearno.

"I'll fly it around until daylight, then I'll try to take her down."

Fearno whistled quietly.

"If you want to," said Dupras, "you can bail out before we go down. I'll have to jettison the canopy anyway so we can get out in a hurry, if we land in one piece."

Buried deep in his radar-studded compartment, Ed Wieland uncomfortably considered the dangers of bailing out. Ejection seats sometimes fly erratically, and parachutes sometimes do not open.

In his tiny cockpit, Joe Fearno reflected on the difficulties of landing a giant bomber without wheels or brakes. Unless Bob Dupras greased his B-47 onto the concrete, the impact might slam all three of them into their instrument panels. A slight crosswind could send the airplane skittering along sideways; if a wing dug in, they might go cartwheeling down

the runway. And even if Dupras did a masterful job, the heat of friction as they skidded would probably ignite the aluminum belly, possibly starting a fire that could cremate them.

But Joe Fearno also did not want to abandon his airplane. "I'd rather stay," he said quietly.

"Ed?"

"I'm with you," said Wieland.

"Okay," said Dupras. "For the last couple hours, Boeing has been working out a special procedure for shutting down the electrical system. If it doesn't work, we'll take her on down."

5:45 AM

The sun came up red as Dupras broke away from his fifth tanker. He headed north, listening carefully to Boeing's shut-down instructions. There were nine complicated steps to be followed. He repeated each one aloud as he wrote it on the pad of his knee-board.

"Now, in case the power does not come back on," intoned Bow Legs, "you're instructed to use runway Zero Six. You'll have a five-knot crosswind about 20 degrees from the left. We've already got a crew putting down foam. That'll help you slide and will reduce the chances of fire."

"Put some vehicles where the foam starts, will you?" asked Dupras.

"Wilco. There'll be trucks on both sides of the runway. Where are you now?"

"I'm at 13,500 and I'm going up to 16,000 before I turn the power off. If you don't hear from me in 15 minutes, you'll know it's out for good."

"Okay, and Bob, we're betting it will come back on."

6:00 AM

In the tower, eight haggard men waited for word. For the first time in 11 hours they could see the crippled B-47. But there was no sound from her radio.

Then it came. "Bow Legs Control—"

A united sigh of relief went up in the tower.

The voice in the B-47 continued: "I'm sorry. It didn't work."

"Bob, both Boeing and Second Air Force Headquarters agree there's nothing else you can try. Why don't you guys

take a last cigarette, then we'll wrap this thing up once and for all."

"Okay, Bow Legs Control. Let's get the show on the road. We just ran out of oxygen!"



6:16 AM Now the heat was really on. Dupras had flown to the Camp Robinson drop area to jettison the canopy. At 8,000 feet, he put the plane on autopilot and turned to look back at Joe Fearn. Except for the final landing, this was the most dangerous part. If the canopy slammed down as it tore loose, it could slice the heads off Dupras and Fearn.

"Ready?" he said.

Joe nodded, and they both hunched forward.

Dupras brushed the jettison button, and the world exploded. The cockpit filled with dust. The B-47 pitched forward. Quickly, Dupras straightened up to grab the controls and the gigantic hand of the slipstream smashed his head back. Its fingers ripped at his oxygen mask. But he was jubilant: The canopy had broken away cleanly.

As he headed back toward Little Rock, Bow Legs Control droned in his ears almost constantly. The tower did not want to infringe on the authority of Dupras as aircraft commander, but they knew that after 16 hours of constant tension, Dupras must have lost the fine edge of flying skill; he needed all the help he could get. "Be sure to stow all loose gear," said Bow Legs.

"Roger," said Dupras. "I've put the files and the sextants under my feet."

"Boeing warns you that with the canopy off, she'll buffet very severely as you approach your best flare speed. She'll be hard to control all the way down."

But control was the least of Dupras' problems now. When the canopy tore loose, it had pulled all three pins on his ejection seat. The seat was now cocked to go off. If Dupras accidentally raised the armrest as much as an inch, he would

be blown out into the sky. Slowly, carefully, he reached up over his shoulder to replace the pins. He inched his arm out into the slipstream, fighting to keep the blast from ripping it out of his shoulder. Minutes later, one pin was in place. One would have to do, he thought wearily.

6:43 AM "Five Nine, better tell Ed to break the safety wire on his hatch so he can blow it as soon as you come to a stop, and . . ."

Dupras cut him off. "Stand by, Control! Engine No. 6 is running rough."

Almost in a daze, he watched his fuel-flow meter. The needle fluctuated wildly. Then it dropped to zero. The airplane yawed sharply to the right as the engine slowed. Dupras retrimmed the plane and studied the meter. "No. 6 is dead," he said.

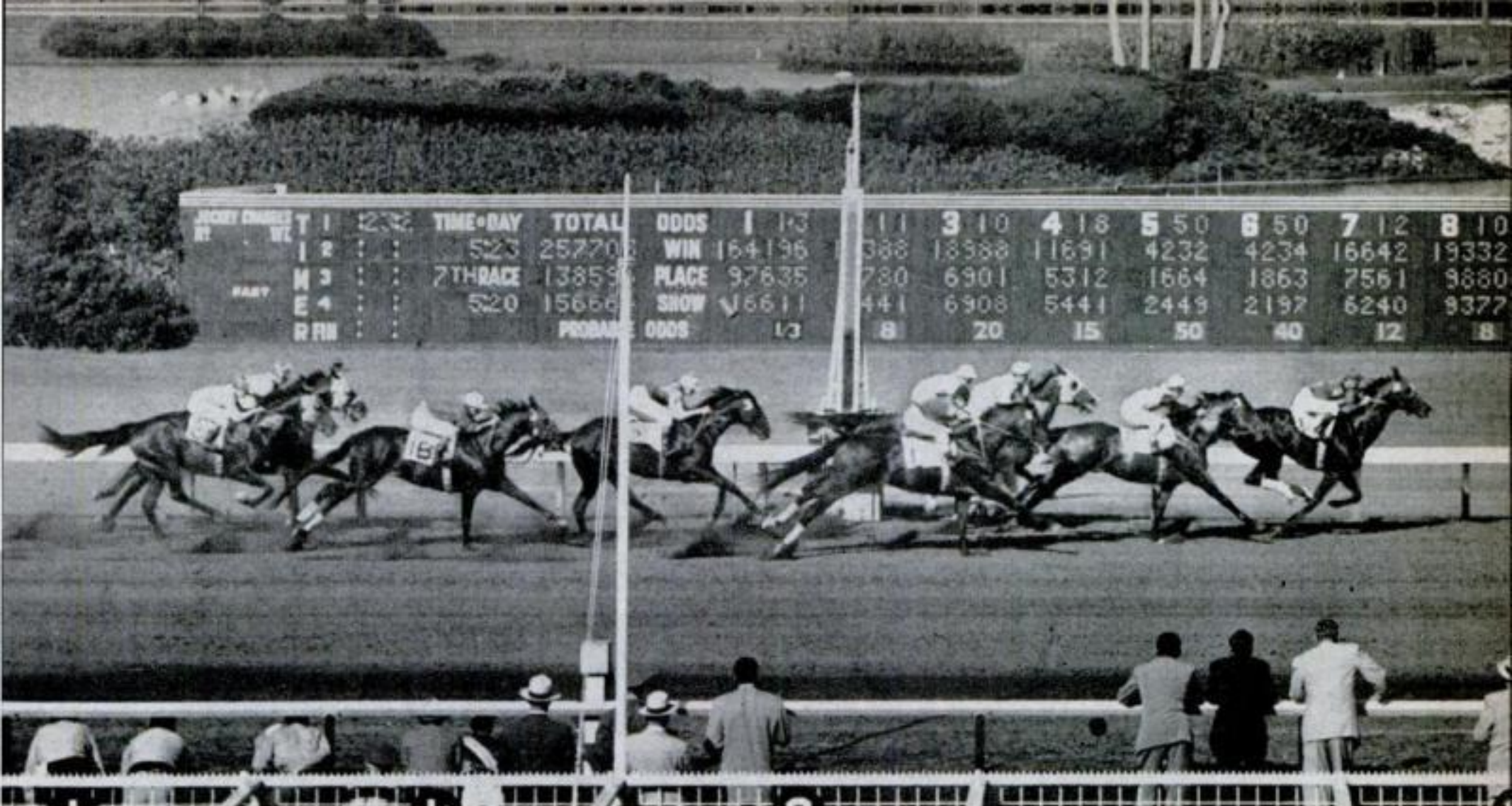


7:29 AM Nine fire trucks, three ambulances and a dozen staff cars waited beside runway Zero Six as the B-47 wheeled onto her downwind leg. Five thousand gallons of foam glistened in a wet streak down the center of the runway. The field was closed to all traffic. In the tower, a colonel described every action over a hot-line phone to Second Air Force Headquarters. In Wichita, a haggard group of Boeing engineers waited. Now it was up to Bob Dupras alone.

At a carefully controlled 151 knots, he nursed his bucking B-47 downwind, then out toward the southwest to bleed off altitude. Over and over again, he went over the final steps of the emergency landing: 1) Pull all fire shut-off switches; 2) lock shoulder harness; 3) hit the alarm bell to warn Joe and Ed that they'd reached the payoff.

He had gone over his weight-and-balance figures 20 times in the last hour. He knew he'd be down to a bare 6,000 pounds of fuel when he flared out, that his weight

[Continued on page 240]



Like a giant cash register, the tote board posts its sales. Above, at Hollywood Park, Cal.

The Amazing "Tote": Billion-Dollar Betting Machine

LAST year, more than 51,000,000 Americans paid to watch horses race, and bet the bewildering sum of \$2,799,000,000 on the outcome. For the fifth year in a row, the so-called sport of kings led all others in popular appeal. For the eighth year in a row, the amount wagered

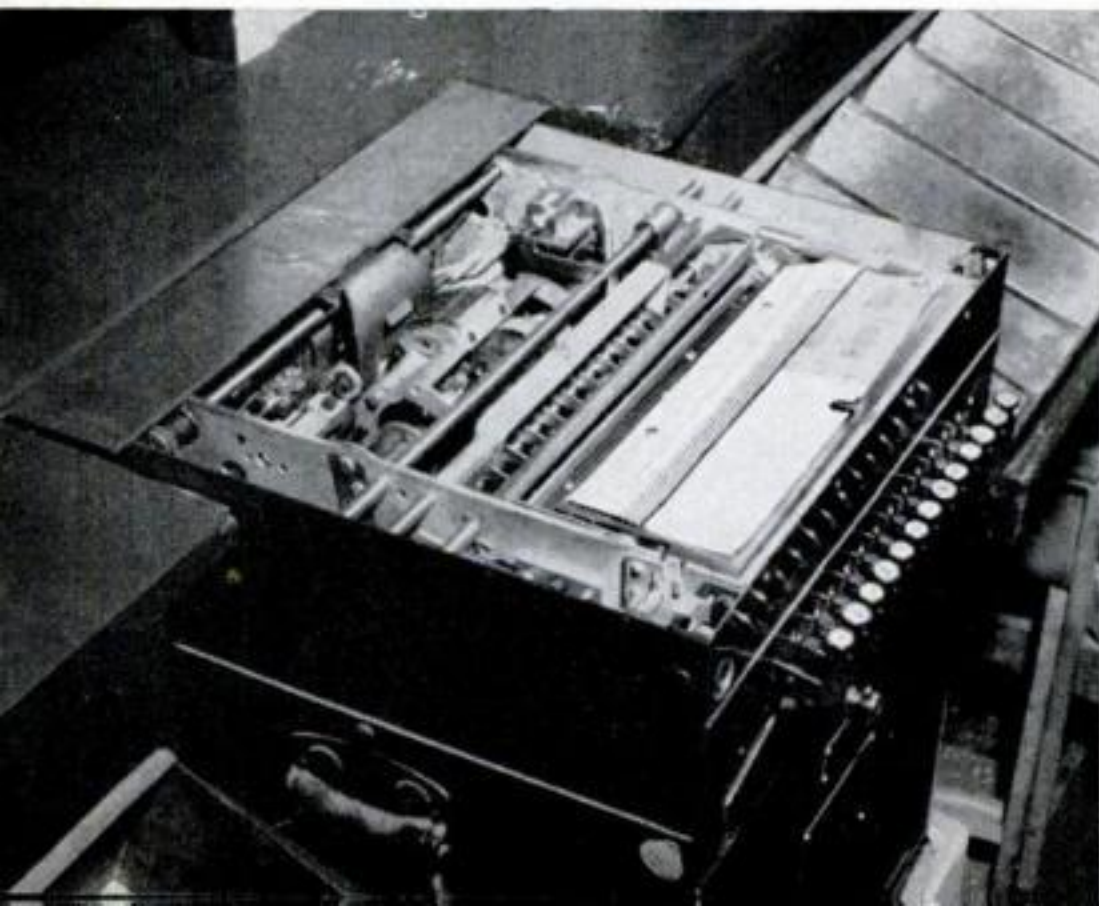
on the horses set a new national record.

"Playing the horses" would never have become the favorite game of millions if it had not been for two players—a Frenchman and an American—who lived a couple of generations apart.

The first was Pierre Oller, a Parisian

TICKET MACHINE (shown with its top off) prints tote tickets, registers on an inserted paper form the total amount bet on each horse in the race, and on all the horses together.

BACKSTAGE WITH THE TOTE: Member of operating crew holds a light box with 24 bulbs. Each of these boxes—there are 287 on the main board—can display any digit from 0 through 9.



Crossed wires are costly . . . On May 15, 1956, a tote overpaid

businessman, who invented pari-mutuel betting. Oller loved to bet on horse races, but he became fed up with having to place his bets with a bookmaker and accept whatever odds the bookie might choose to offer him.

"*Why not bet among ourselves?*" he asked a few fellow racing fans, along about 1865. (Mutual betting is what the French term *pari mutuel* means.)

Here is what Oller had in mind: If he knew how much money had been bet on all the horses in a race, and what proportion of the total sum had been wagered on each horse to win, he could easily calculate odds that would accurately reflect the mass judgment of the bettors. The more of them there were who bet on a particular horse, the lower the odds on that nag would be. What could be fairer to gamblers than that?

At the birth of pari-mutuel betting, Oller himself held the stakes, calculated the odds and made the payoffs. Those who had bet on a horse that won a race

divided the money that had been bet on all the other horses in the race, in shares commensurate with the size of their wagers.

That is still the essence of pari-mutuel betting, though it has grown complex with age. Because of its indisputable fairness, it rapidly became popular. Very soon, individuals no longer could hold the stakes and make the calculations. First clubs and then racetrack managements took over the burden, hiring betting-ticket sellers and accountants by the hundreds. As the crowds of bettors increased, even this army of calculators couldn't make an up-to-the-minute accounting of the flood of cash or the way it was bet. The estimating of odds at tracks lagged farther and farther behind the actual betting.

That irritating situation led Henry L. Straus, a young Johns Hopkins math professor, to invent the marvelous totalizer—or "tote," as the nation's horse followers and racing writers call it—that now keeps instant track of all the bets at nearly every race course in the U. S. Without the tote, a kind of giant electric cash register, pari-mutuel betting on its present scale would be impossible.

One day in 1927, at Havre de Grace, Straus got particularly annoyed when he was paid off on a winning ticket at odds far lower than the last he had seen posted.

He wasn't being gypped. The final, correct odds simply hadn't been calculated until he stood in front of the cashier's window.

He left the track, fuming, with the idea that he could devise a way to register horse-betting automatically.

The method he devised—with the help of A. J. Johnston, a General Electric expert on telephone circuitry—is now in operation at most of the nation's tracks. It made its debut at

Arlington Park, Ill., in 1933.

Here are the principal parts of a Straus tote:

- Ticket machines, of which there may be as many as 411 (at Santa Anita).

- A collector and dispatcher of electrical signals from the ticket machines—a sort of robot traffic cop.

- 39 adding machines, which register the signals coming to them through the collector, and which look nothing like ordinary adding machines.

- An electronic odds calculator.

- A display board, which normally stands in the infield of a racetrack, facing the crowd. The largest board is 180 feet wide and 12 feet high. Some tracks have two of these. Each accommodates miles of wiring, thousands of electric lights and a high, narrow room for a crew of men

The Day Beer Stopped the Betting

One grim afternoon at a Southern California track, a few minutes before the day's betting was to open, a tote manager discovered that one whole section of the collector was dead. In a frantic search for the trouble, he found that beer from a bar on the level above had seeped through the floor, dripped into that portion of the collector and shorted every jackplug in it. The afternoon's racing was inexorably delayed a full half-hour, while impatient fans fumed at the ticket windows and fretful track officials hectoring the tote-room crew, until every jackplug in the crippled area had been cleaned out with carbon tetrachloride.

Daily Double winners \$77,000

ready at any instant to deal with a faulty wire or replace a dead bulb.

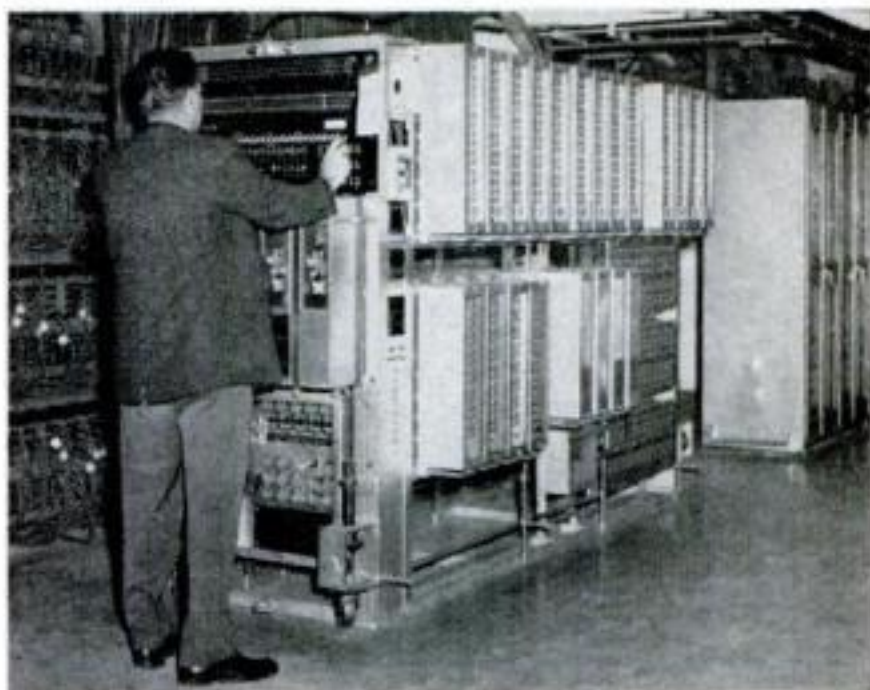
Each of the tote's ticket machines prints and sells tickets for only one size of bet—out of seven that are possible at most tracks. It can turn out about 50 tickets a minute. But the tote's massed adding machines can record bets from 21 ticket machines at a time, in 30 thousandths of a second. They keep a constant record of how much money has been wagered and how the bets have been placed. Every 90 seconds during the period before a race starts, the tote automatically flashes the latest results of this furious accounting across the face of the infield board. At the same time, it posts there in lights the up-to-the-minute, approximate odds on each horse to win the race—estimated by the calculator.

As the race starts, an official presses a button that locks every ticket machine at the track and instantly halts the betting. The lighted record of bets and odds remains frozen on the tote board during the race. Within a few seconds after the finish, the board displays the winner's number and time, the numbers of the horses that came in second and third, and the payoffs on those three horses.

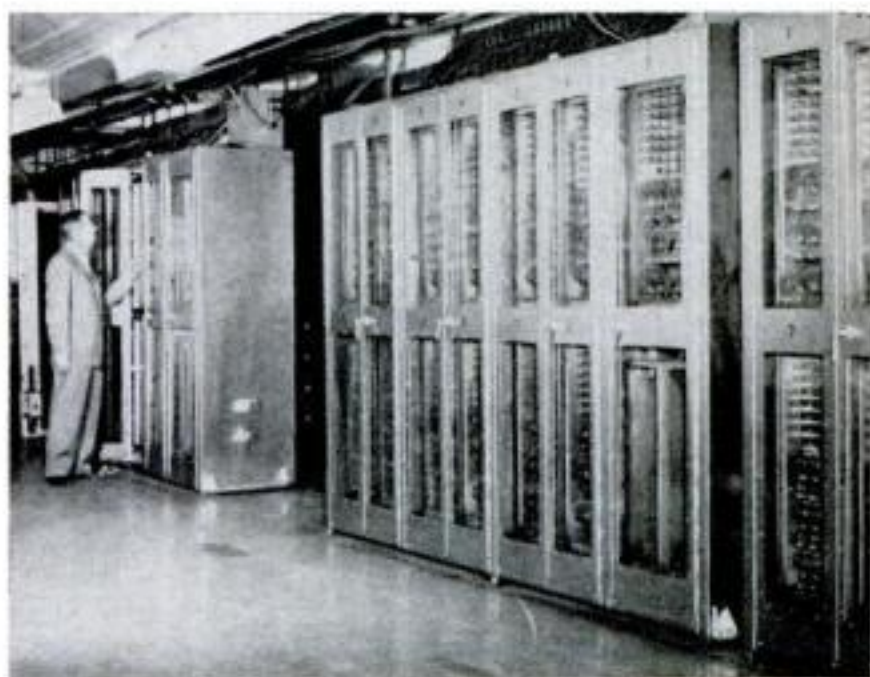
The payoffs shown in lights on the tote board are always figured for the two-dollar bettor, who makes up most of the betting population at any track. And they are calculated by men, not machines, though the men use the tote's odds.

The Straus tote, which is built and owned by the American Totalisator Co., is really first cousin to a dial-telephone system. They both use the same kinds of relays and rotary switches. In the telephone system, the rotary switches put calls through. In the tote, they turn on lights and display on the tote board the latest messages from adding machines and odds-computer. The tote's collector, which gathers incoming signals from all the ticket machines at a racetrack, works like the telephone system's line-finder. It completes a circuit to the proper adding machine for each ticket issuer as the electrical impulses pile in, and, in effect, gives a busy signal to the others until their turns come.

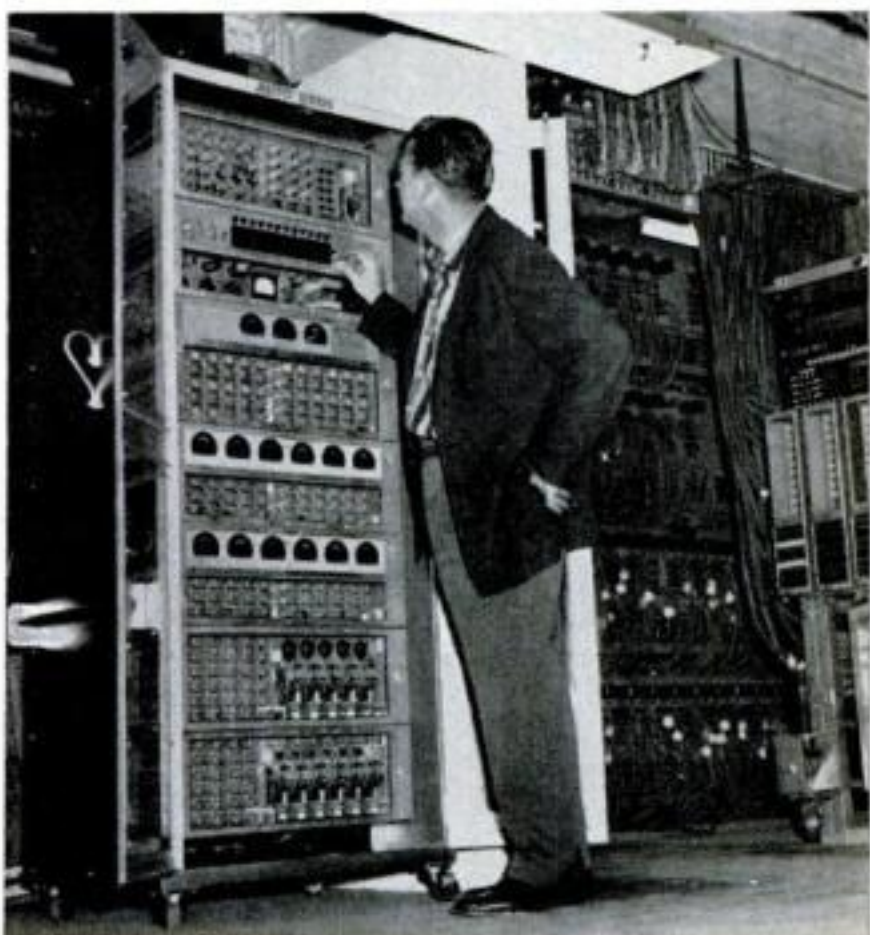
The Straus tote has two marks of distinction: It is portable, and it isn't for



THE COLLECTOR: This complex electronic instrument closes a circuit just long enough (30 thousandths of a second) to record a single bet.



THE POOL ADDING MACHINES: The one at far left totals "win" bets, the center unit "place" bets, the one at right "show" bets.



THE AUTOMATIC ODDS COMPUTER: Every 90 seconds this calculator takes the latest totals from all the adding machines, figures out new odds.



CLOSED-CIRCUIT TV SYSTEM lets men in tote room, down under the stands, keep a constant watch on the board. Cameras are controlled from the switchboard at the man's left hand.

sale. Though the tote at full tilt utilizes about 300 miles of wiring and weighs around 150,000 pounds, two dozen men can take it apart and have it on its way to another track in six hours. Most of the wiring stays put. The mechanism is largely compartmented, and its units can be hung on hooks in steel frames at any track and plugged in.

Straus totes, like many costly business machines, are rented, not sold. The company collects a tiny fraction of the tote's "handle" as rent, and in return provides the tote and a crew to keep it working.

Most of the tote's parts are out of public sight and reach, and always under the eye of some vigilant crew member. So malicious mischief is a very unlikely threat. But a part may abruptly break. Wiring can suddenly become faulty—and crossed wires in a tote can be terribly costly. This happened (but not to a Straus tote) at Bay Meadows, near San Francisco, on May 15, 1956. As a result, holders of winning Daily Double tickets were overpaid \$77,000.

American Totalisator crews never take it for granted that because a tote worked fine yesterday, it will today. Always, before a day's races start, the whole, sprawling, intricate system is given a workout.

First, all the betting circuits and all the lights are tried out. Then comes the "crash" test: The No. 1 button on every ticket machine on the grounds is pressed down and attempts, as a master switch is thrown, to register its test bet. This is the

supreme trial for the collector, its greatest possible overload. Ordinarily it undergoes this unlikely ordeal calmly, handling 21 bets at a time without a sign of palpitation. But the testers daily make sure.

The fabulous tote goes about its intricate day's work with very little fuss. Even on such a stupendous day as May 5, 1956, at Churchill Downs, Ky., when it accounted for \$4,360,232 worth of gambling, the tote is largely silent. Only a subdued chatter of relays reveals that it is doing anything at all.

Arrayed in steel cabinets, behind locked glass doors, the parts of the tote that lie below stands look rugged and dependable. Mostly, they are. Parts and wiring seldom act up. In case of main-line power failure, which happens occasionally, a standby bank of 39 four-volt storage batteries instantly takes over. The batteries run everything but the tote-board lights. At some tracks, a gasoline-powered generator is stored inside the tote board for just such an emergency.

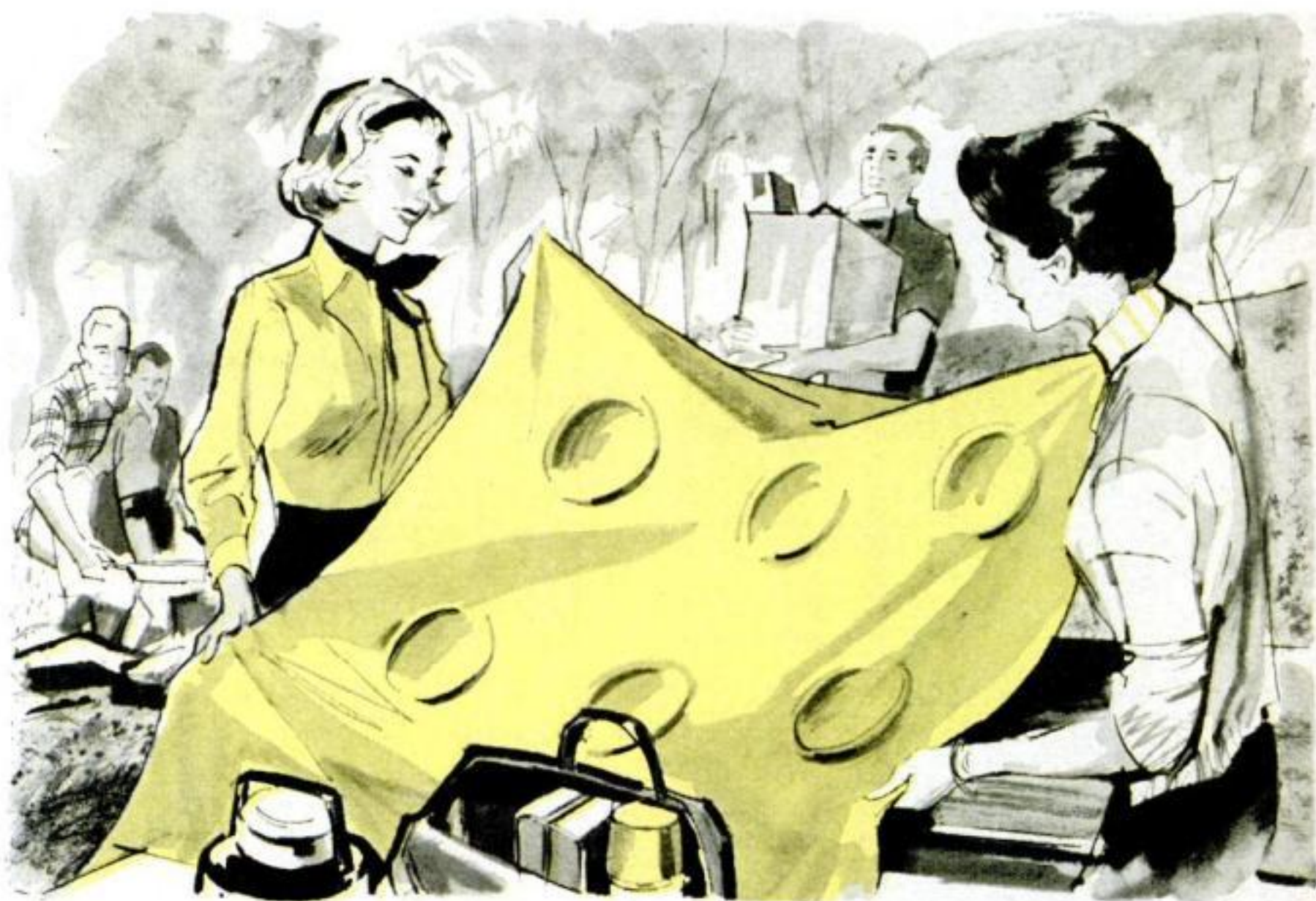
Pari-mutuel betting garnered \$207,000,000 in tax revenue last year for the 25 states where it is legal. Tax collectors in those states love the totalizator, and so do the track owners. Its unassailable honesty encourages lots of people to bet, thus increasing the take for both state and track. Both are sure of getting their money, and promptly. Whenever the tote computes odds, it first automatically deducts the state's and track's combined share (ranging from 10 to 16 percent) from the sums bet on all the horses, and bases its odds on the net totals. Thus they never can lose a cent, no matter how heavy the payoff is.

Even bookmakers, wherever they still manage to elude the police, are fond of the tote. That's because they pay off according to the published tote odds, and since they personally are not burdened by the necessity of contributing a percentage to state and track, that is always a hidden asset.

Harry Straus's tote eventually made him a millionaire and enabled him to become a noted breeder of horses and cattle. Tragically, he died in his early fifties. He and Johnston—the man who helped him create his remarkable betting machine—were killed over Maryland on Oct. 25, 1949, when a private plane exploded in midair.—*Wesley S. Griswold.*

New Ideas from the Inventors

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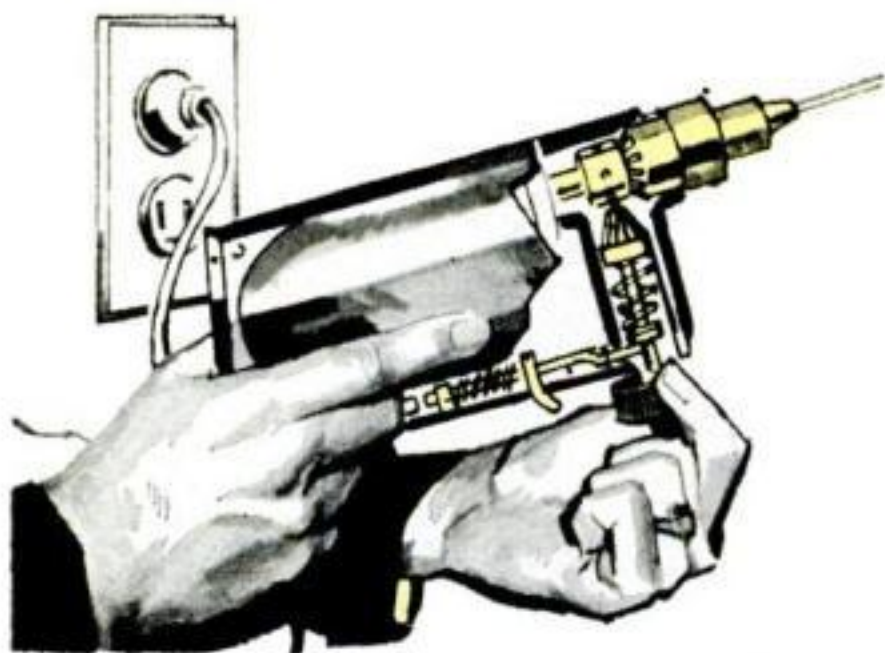


1 Tablecloth Sets Itself. A plastic table cover with built-in dishes might simplify picnic packing, table setting, and clean-up. In one form of this recent pat-

ent, plates would be bonded to the cloth; in another version, they'd be removable—attached by means of metal or plastic forms and retaining rings.

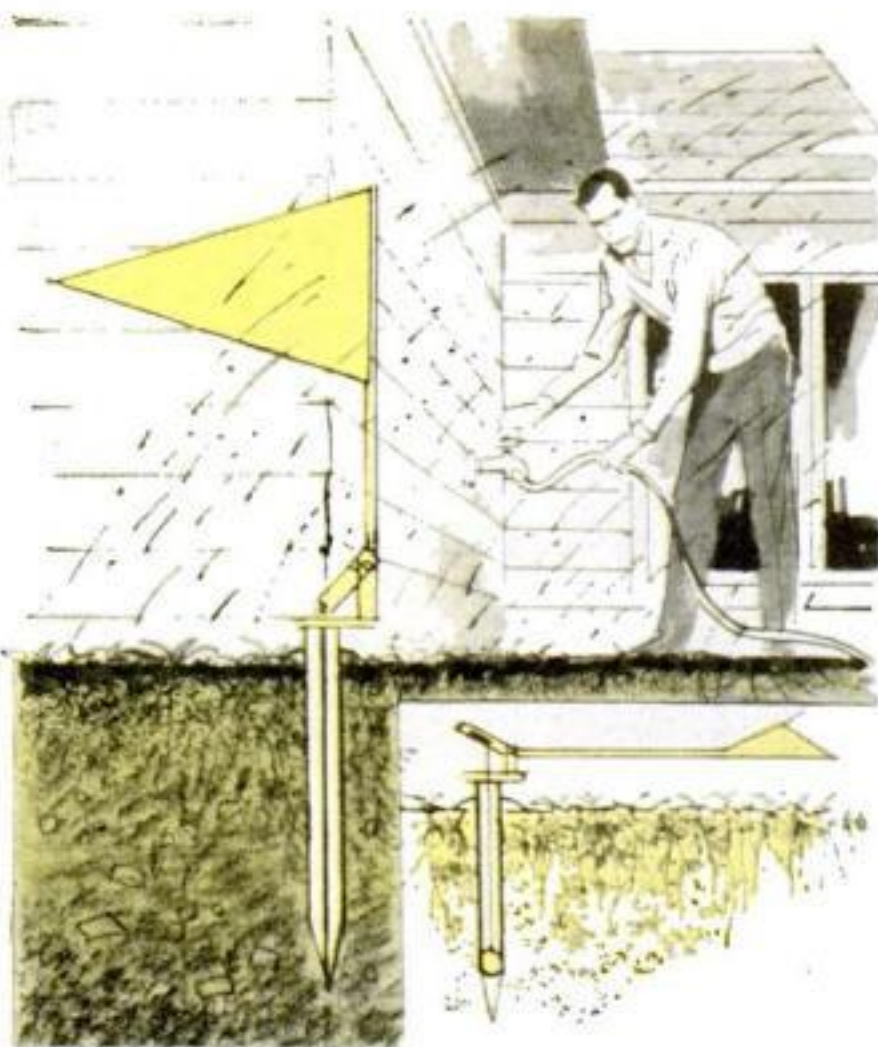
2 Built-in Key Works Chuck Jaws. Changing drills and attachments might be simpler if your chuck had this unlosable, no-fumble key. To engage it, you'd merely press it forward against a spring. A switch would keep the drill from starting until the key was disengaged.

3 Pump-Up Umbrella Fits Pocket. With this compact cylinder stowed away, you'd be all set to outwit sudden squalls. Part of the telescoping, pocket-sized tube would serve as both pump and handle, the other part would provide storage space for an inflatable plastic rain shield.



Please turn the page for more new ideas

MAY 1958 139

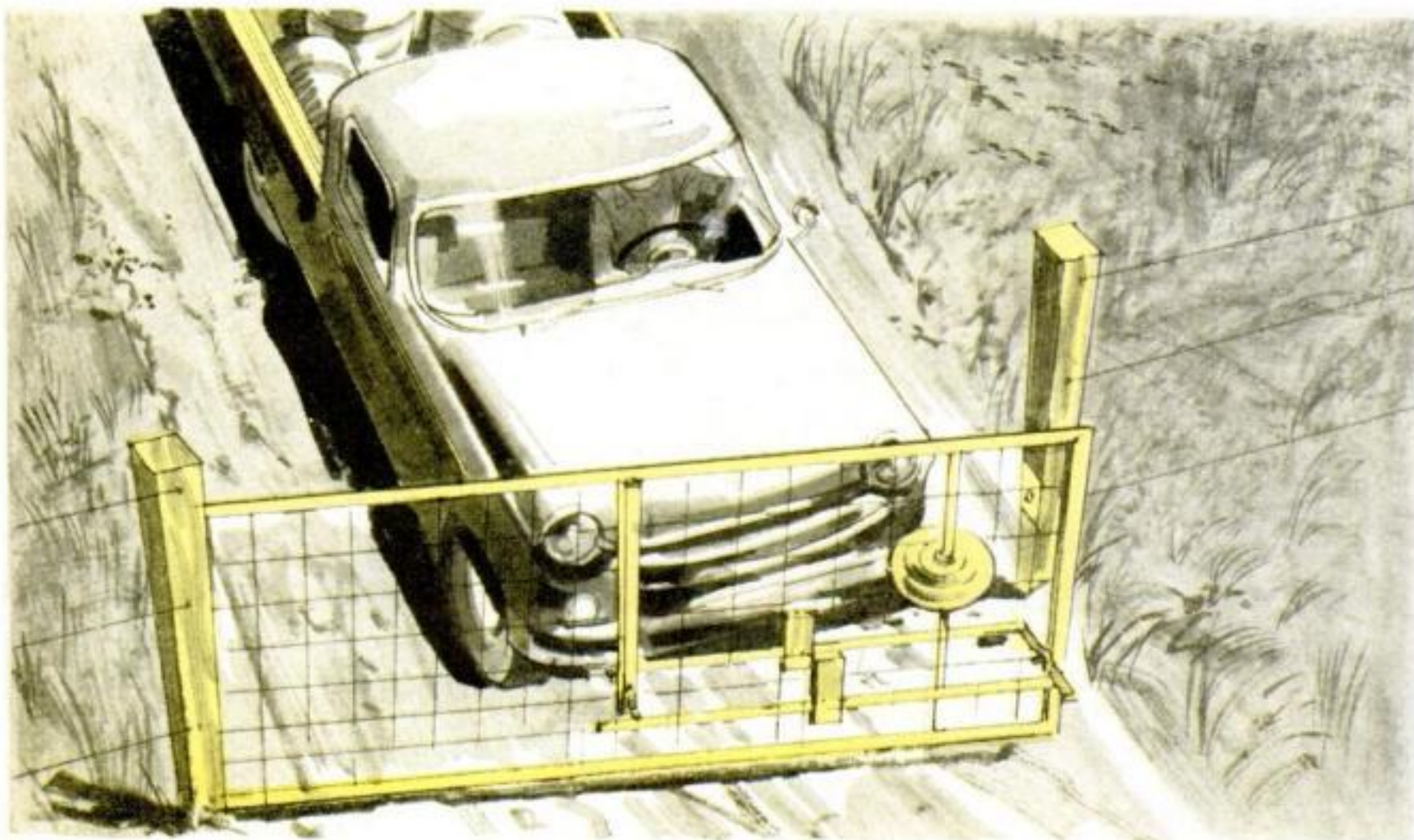


4 Cup Cools Your Drink. To chill a beverage in a hurry, you'd pour it into this steinlike cup and puncture a carbon-dioxide cartridge by turning a thumb-screw. Gas escaping—and expanding—through a coiled tube between the inner and outer walls would act as a refrigerant.

5 Tablet Times Sprinkler. You'd know when your lawn was properly watered if you had this depth gauge and signal on the job. Until moisture reached it, a water-soluble pill placed in the ground stake would block a spring-loaded plunger. Then the pin would drop and raise a flag.

6 Driveway Gate Pushes Open. Even in good weather the routine of opening and closing a gate is one most drivers would gladly skip. Bumper pressure

against a cam on this gate would unlatch and swing it open either way. It would also lift a set of hinge rollers. These, reseated by gravity, would shut the gate.





7 Carrier Locks to Golf Clubs. A golfer who likes to travel light could slip one or more clubs into these paired padlocks and take off for the green. Left on while the clubs were checked or in transit, the lock-handle would keep them together and prevent unauthorized use.

8 Egg Lifter Slices Shells, Too. Tender-skinned diners who burn their fingers on soft-boiled eggs may get help from this device. It is designed to lift the hot spheres from boiling water, then simplify opening them by slicing part way through the shells. A wire loop at the base would cradle the egg; squeezing a trigger in the handle would bring down a blade.



9 Light Board Guides Shoppers. An indexing system like this might make it easier for occasional shoppers to find their way through a supermarket maze. Pushing a button next to the name of an item listed on a directory would flash a light on a keyed map of the store, or over the appropriate counter, or at both.

The following patents have been issued on these inventions: 1. Patent No. 2,792,667 to G. S. Padial, Caracas, Venezuela; 2. No. 2,807,732 to Joseph Kurtovich, Duluth, Minn.; 3. No. 2,810,391 to John Paul Jones, Jr., Pottstown, Pa.; 4. No. 2,805,556 to Wensan Wang, Tokyo; 5. No. 2,740,371 to Gorman R. Nelson, Sioux Falls, S. D.; 6. No. 2,742,722 to Harry P. Schaefer, Cisco, Tex.; 7. No. 2,738,113 to Marshall D. Sigler, Richmond, Va.; 8. No. 2,795,252 to Earl K. Thorne, Pomeroy, Pa.; 9. No. 2,808,579 to Francis J. McCarthy, San Francisco. Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D. C., at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.

Layer-cake look vanishes with these tricks for:

Hiding Plywood Edges

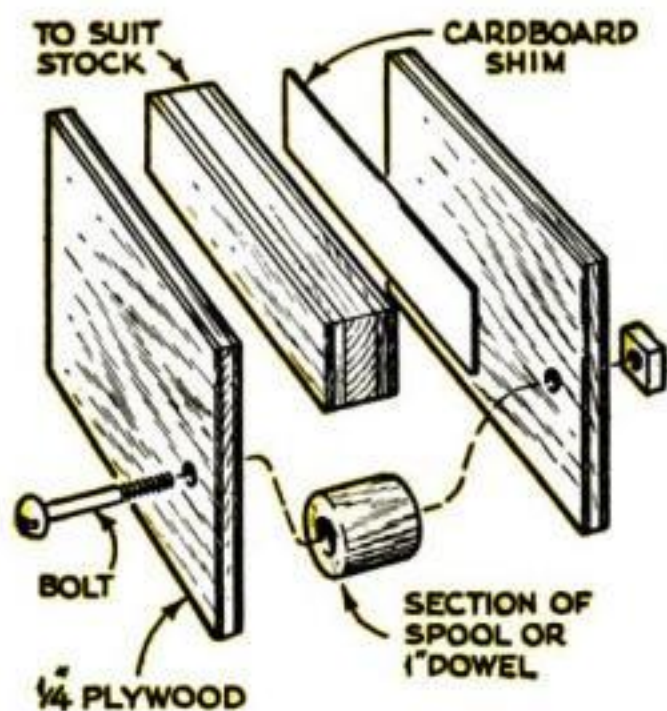
MAYBE you don't mind seeing end grain or corewood in your natural-finish plywood projects. If so, fine. But if you feel that hardwood-veneered plywood, or fir plywood with a grain-taming finish, deserves a solid-wood look all the way around, you can have it in a variety of eye-filling and craftsman-like ways.

First on the list is commercial edging tape, which comes in handy 8' rolls and is now available in practically every wood grain used for veneering plywood faces. Some of these tapes have self-adhesive backing. Others must be glued in place—preferably with contact cement. Both are so thin that their edges can hardly be seen. That's good for the solid-wood illusion. It also makes these tapes the right choice for banding curved or circular edges. One caution, though: Because

commercial tapes are so thin, the panel edges and joints you apply them to must be absolutely flat. Otherwise it's impossible to align them perfectly, and telltale rippling will show through.

If you're very fussy, you may object to a slight difference between face veneering and edging tape. This can't be helped because no two pieces of wood are exactly alike, and the same goes for veneers. If this troubles you, your best bet is to cut your own tape, using strips removed from the parent panels. These can be made wager-thin with power sanding.

Want something even finer? Then try your hand at making invisible edge and end joints. As the photos on this and the following four pages show, the table-saw setups are simple, and the results well worth the little time it takes to produce the best of plywood edges.



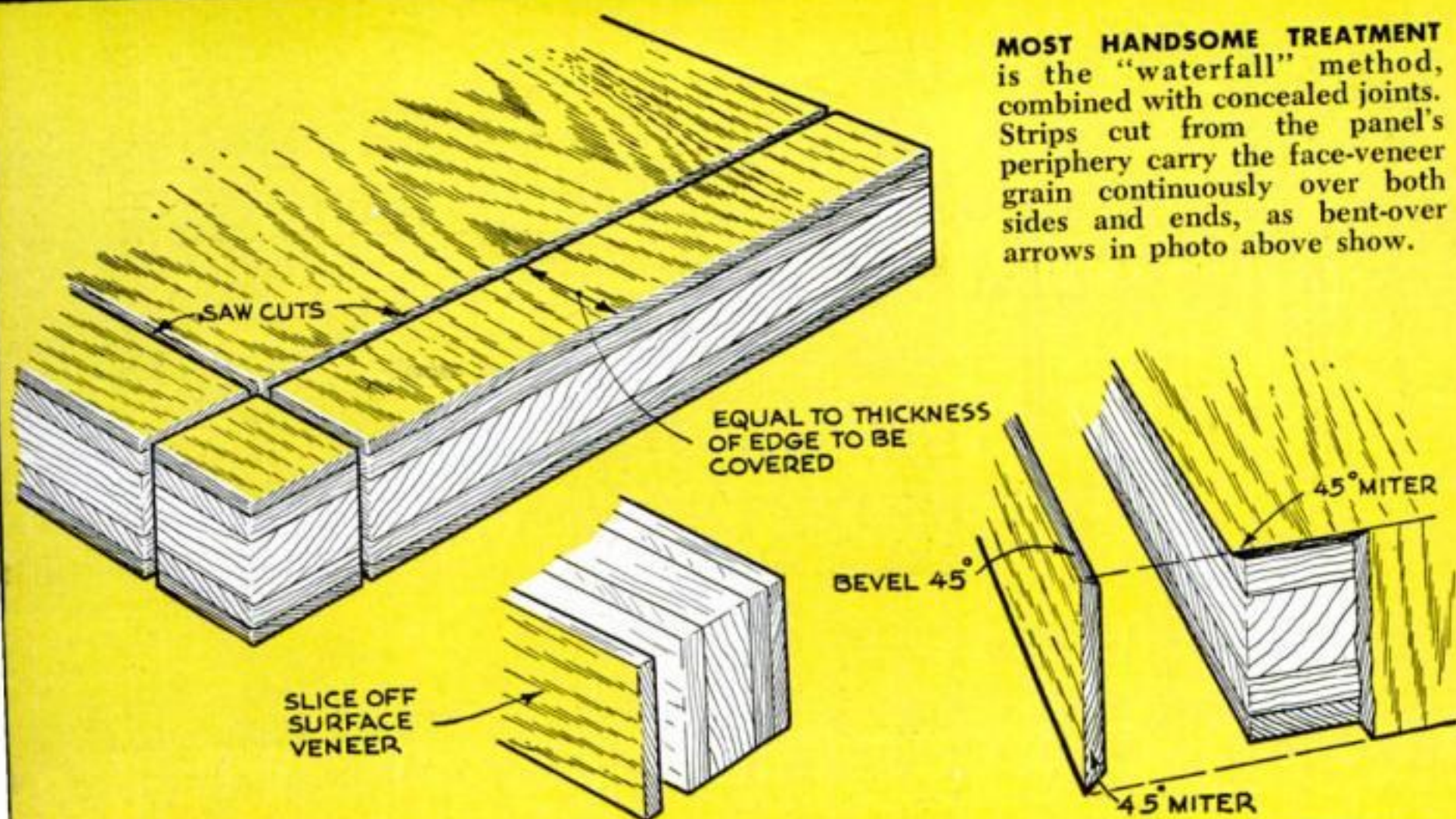
EASILY MADE GUIDE and roller speed the job of aligning and applying edging tape. Leave circular work on the lathe while you reel the veneer strip into place.



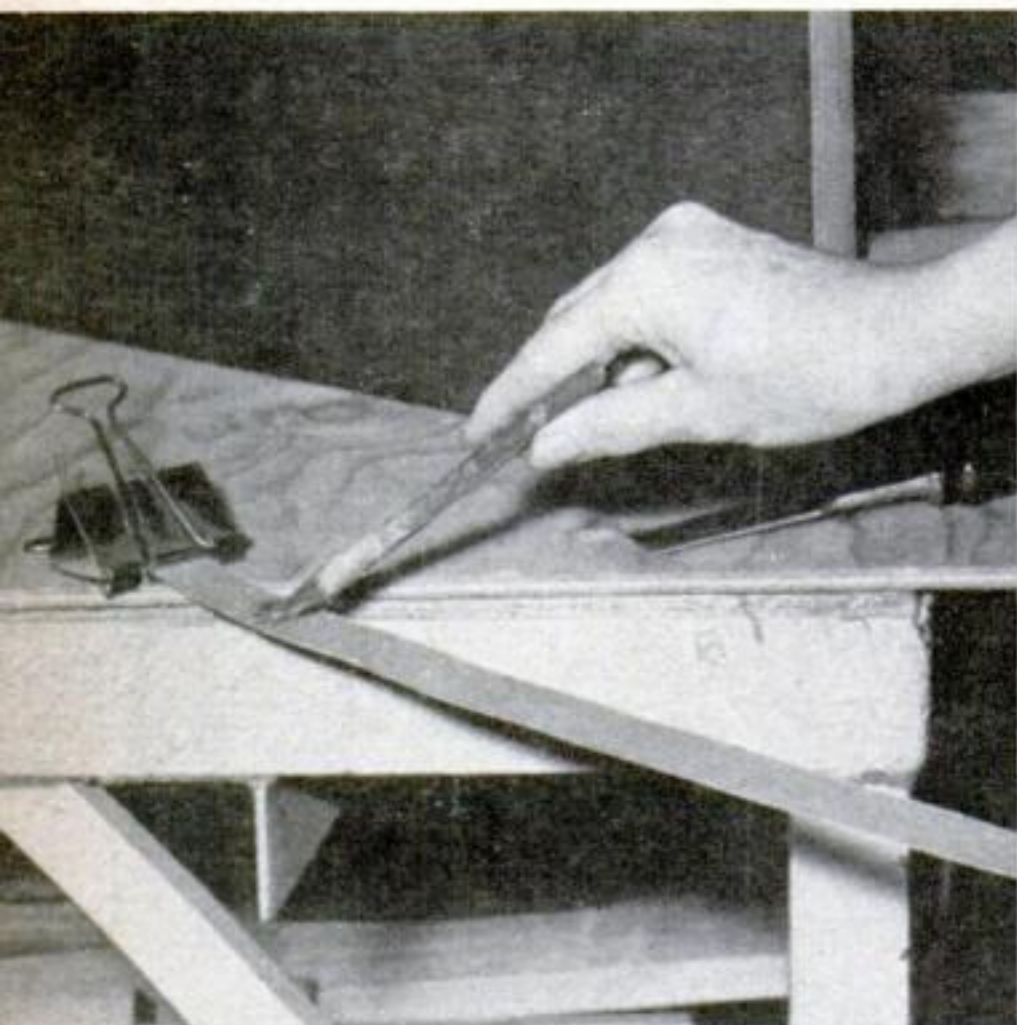
Home and Shop



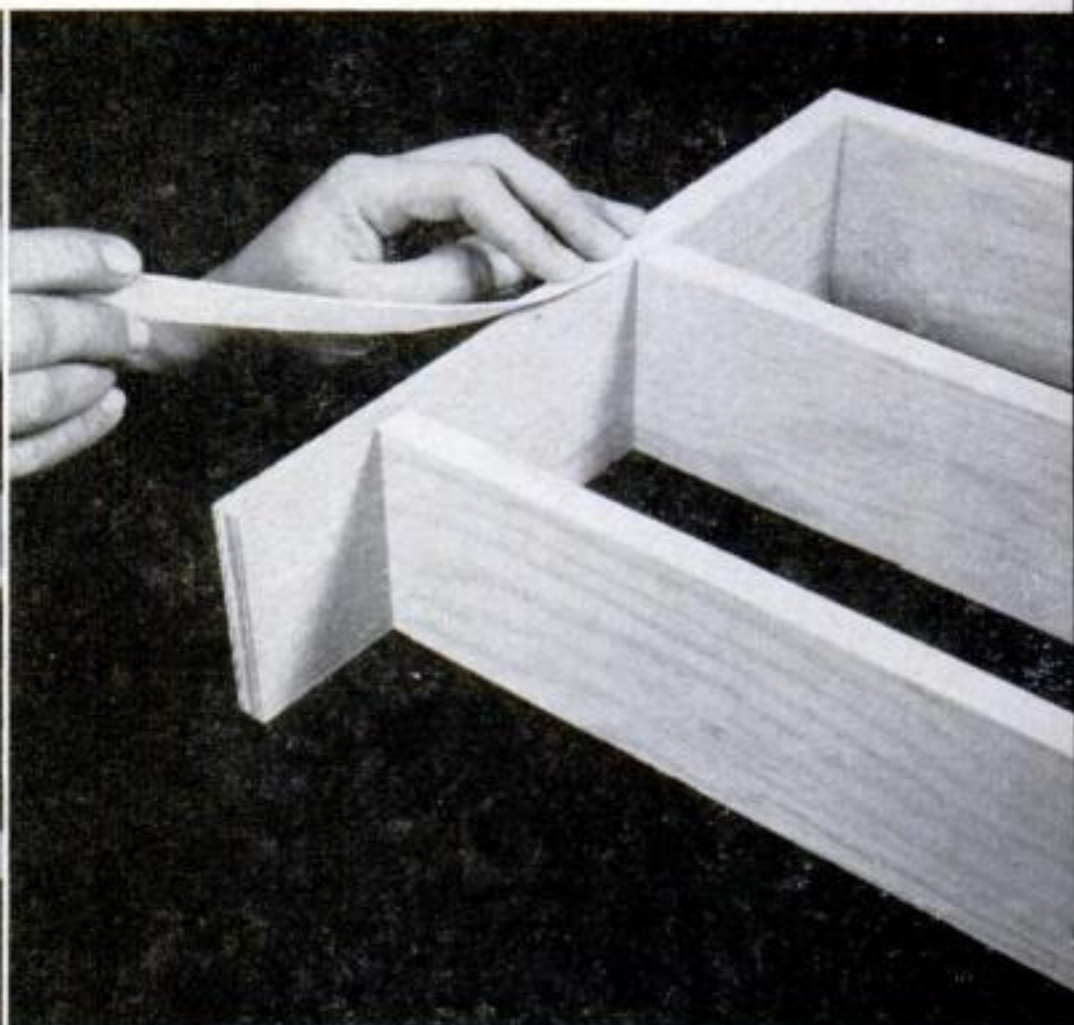
MOST HANDSOME TREATMENT is the "waterfall" method, combined with concealed joints. Strips cut from the panel's periphery carry the face-veneer grain continuously over both sides and ends, as bent-over arrows in photo above show.



Simple tape tips you should know.....

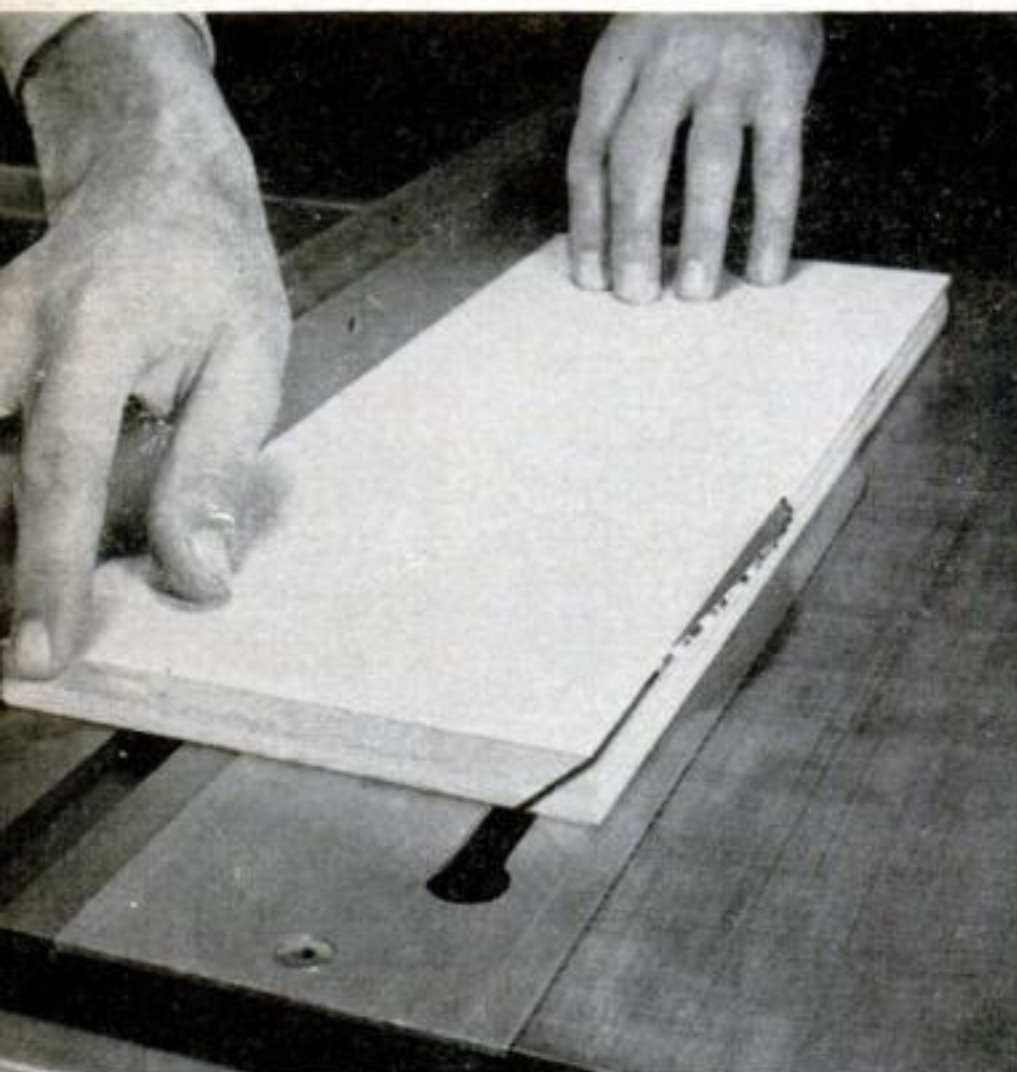


HOLDING THE PAPER-THIN TAPE while you apply solvent to the back of the self-adhesive type, or contact cement to the glueless kind, can be done effectively with a spring paper clip nailed to your bench top. Tension the ribbon of veneer between the clip and your free hand.

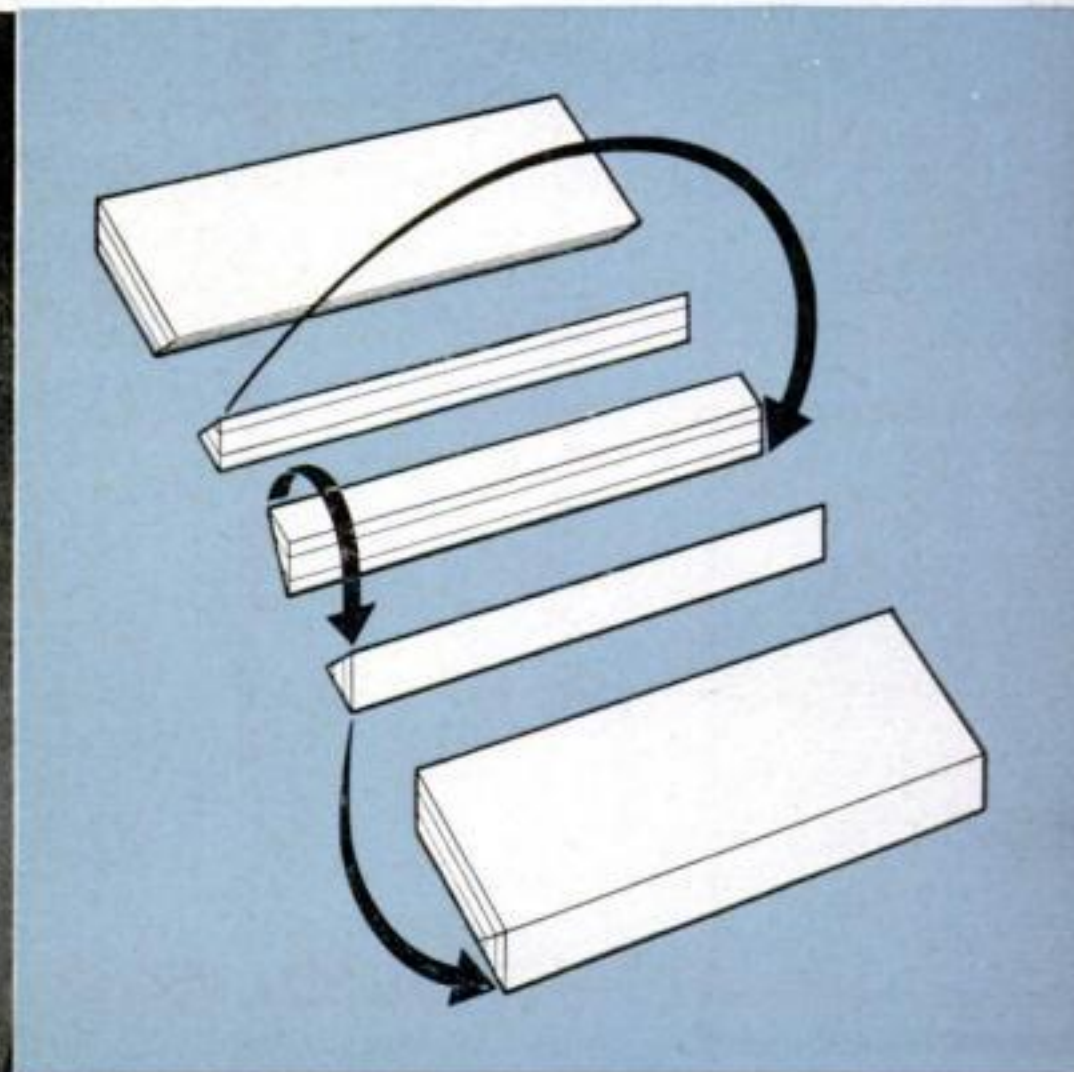


CARE IN ALIGNING TAPE when you press it into place—and beforehand, in leveling the surfaces to be covered—are both extremely important to the success of an edge-veneering job. Here, homemade tape, cut from strips of the work stock, insures a perfect color match.

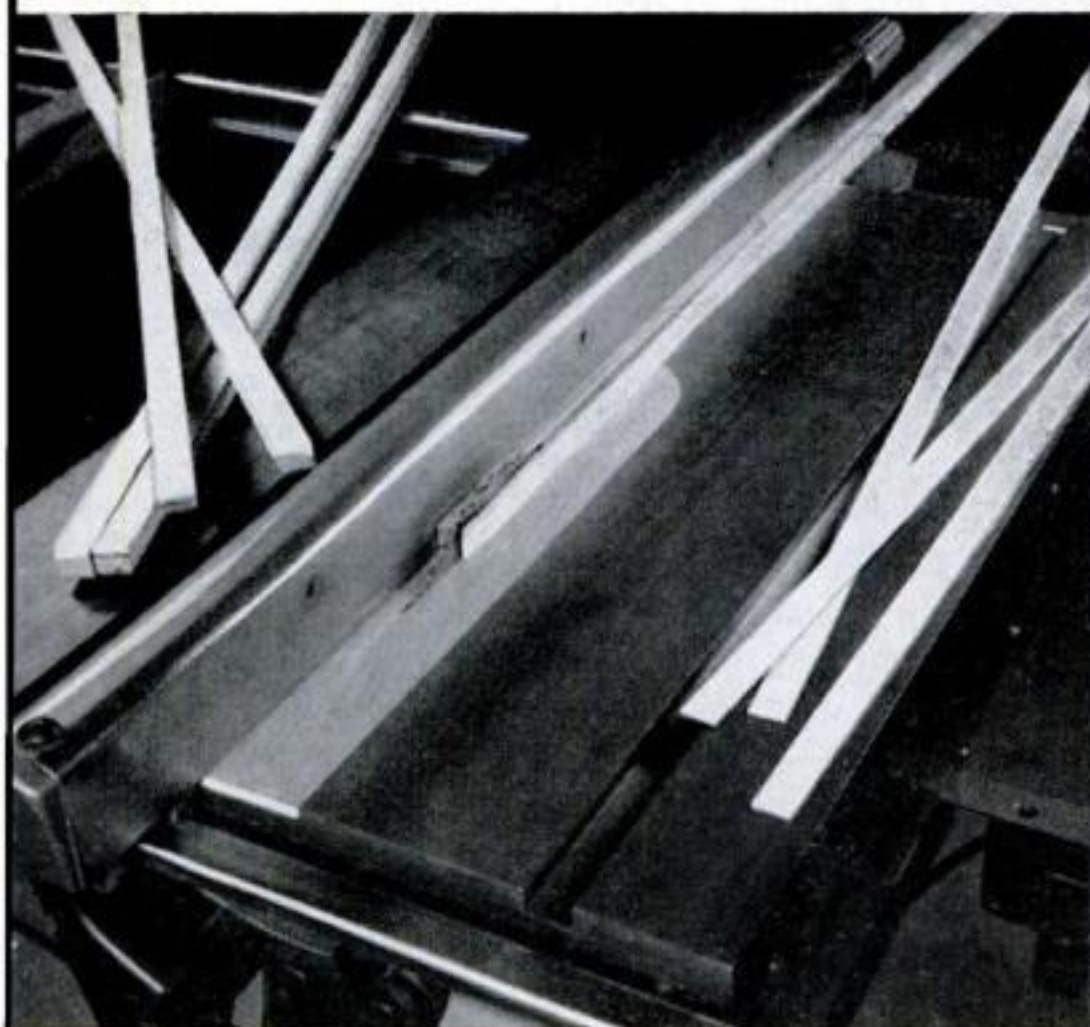
These edges hide their glue joints.....



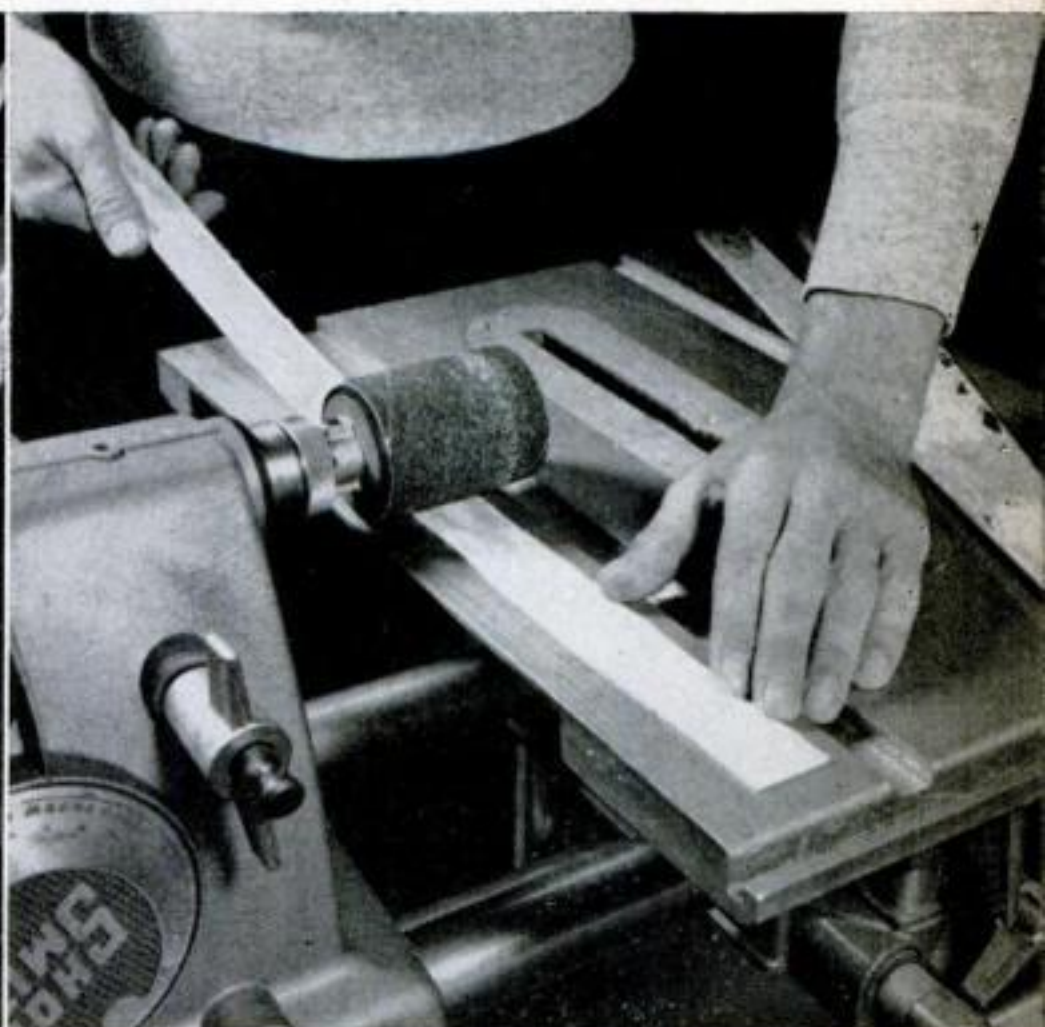
MITER EDGING gives table and counter tops that solid-wood look with just one pass through the saw for each edge. Make a 45-degree cut that does not reduce the thickness of the cutoff.



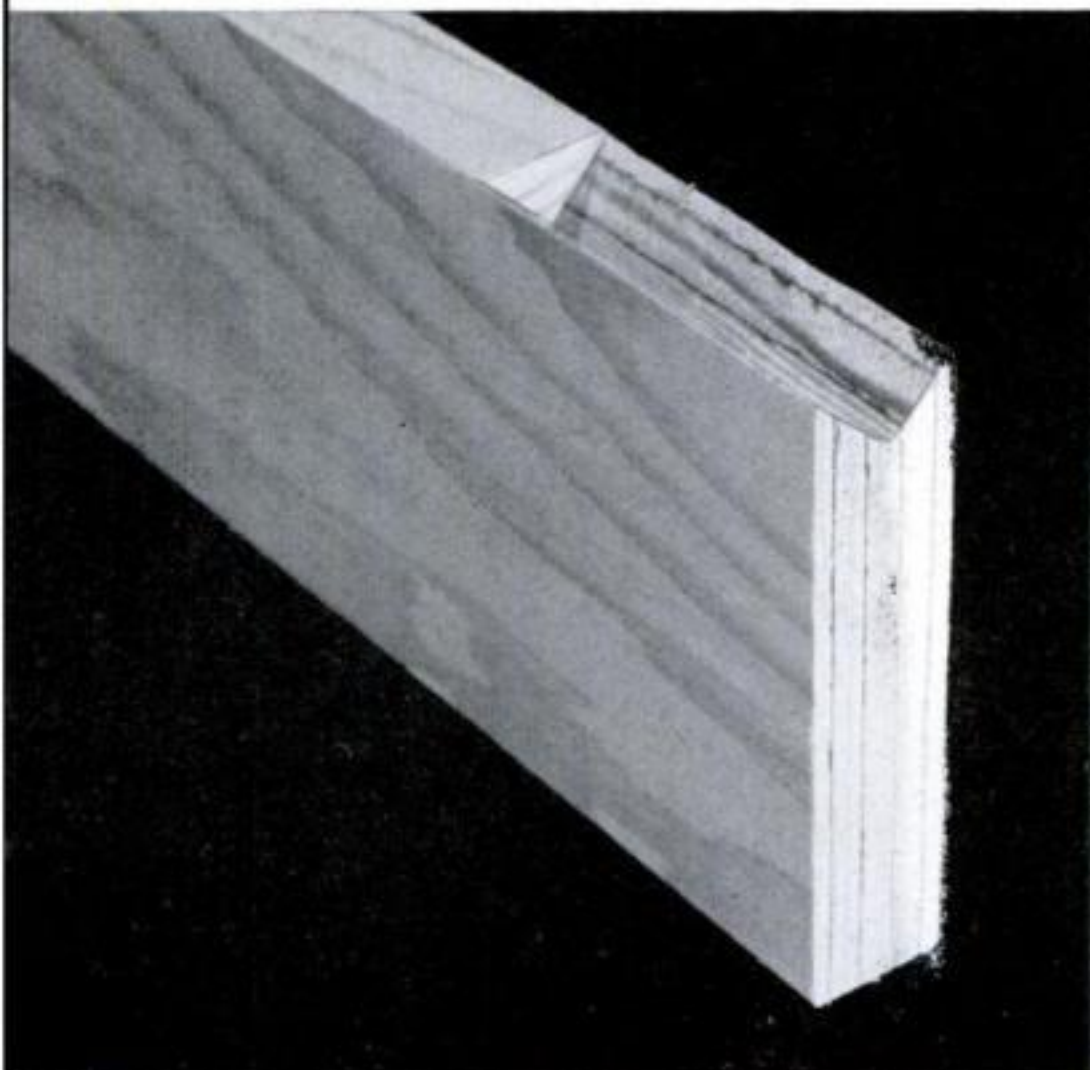
Turn the cutoff end-over-end, give it a quarter turn on its axis, and glue it back on the parent stock. This way, the veneered undersurface becomes the new exposed edge.



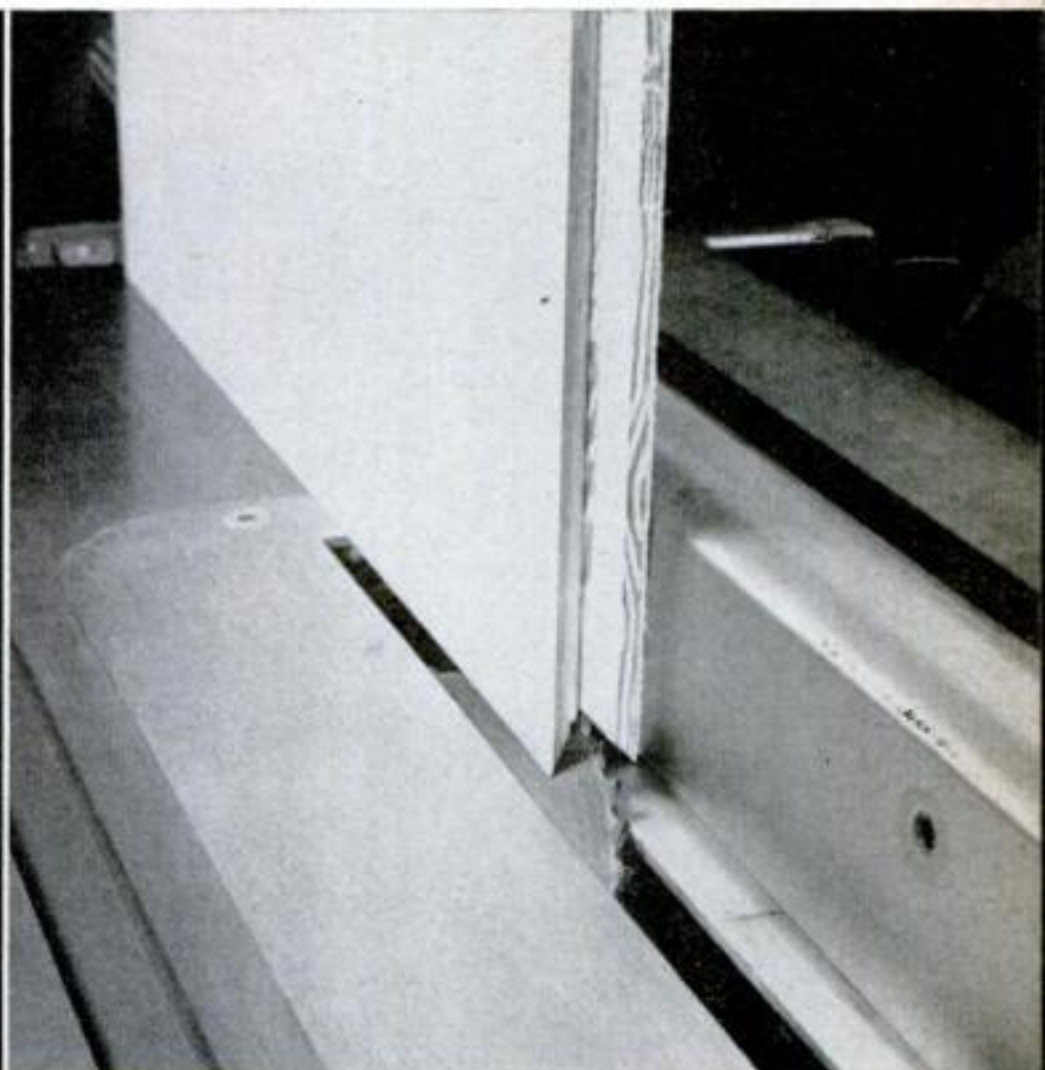
TAPING STRIPS, custom-tailored on your saw, won't be drawn down into the table slot if you make a hardwood inset and let the blade cut its own clearway. Run off the strips of tape slightly wider than the edges to be covered, and sand down the overhangs after cementing.



POWER SANDING lets you reduce veneer strips to wafer thinness. With a multiple-purpose shop tool, a drum sander does the trick. As an alternate, you can use a disk sander chucked in a drill press. Either way, always feed strips against the rotary action of the sander.

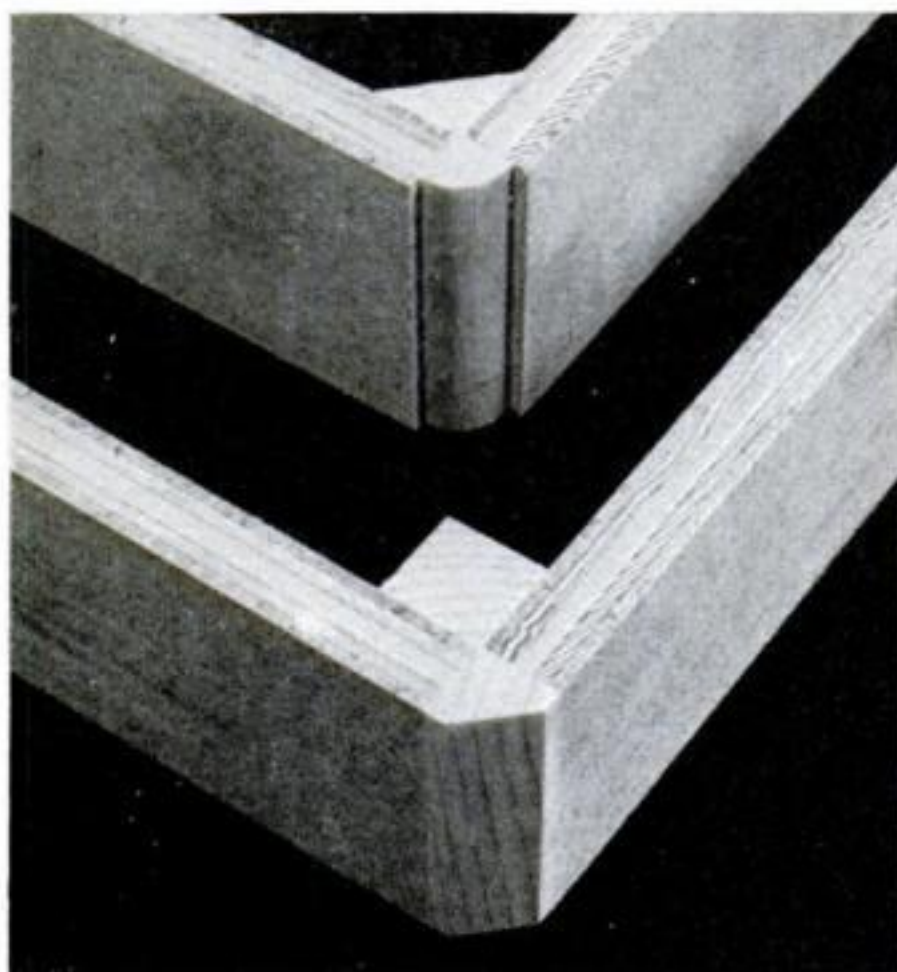


V-SHAPED EDGING is a natural for hinged cabinet doors and small panels which will be viewed from both sides. Here, triangular-shaped strips are glued into matching grooves. Set up the

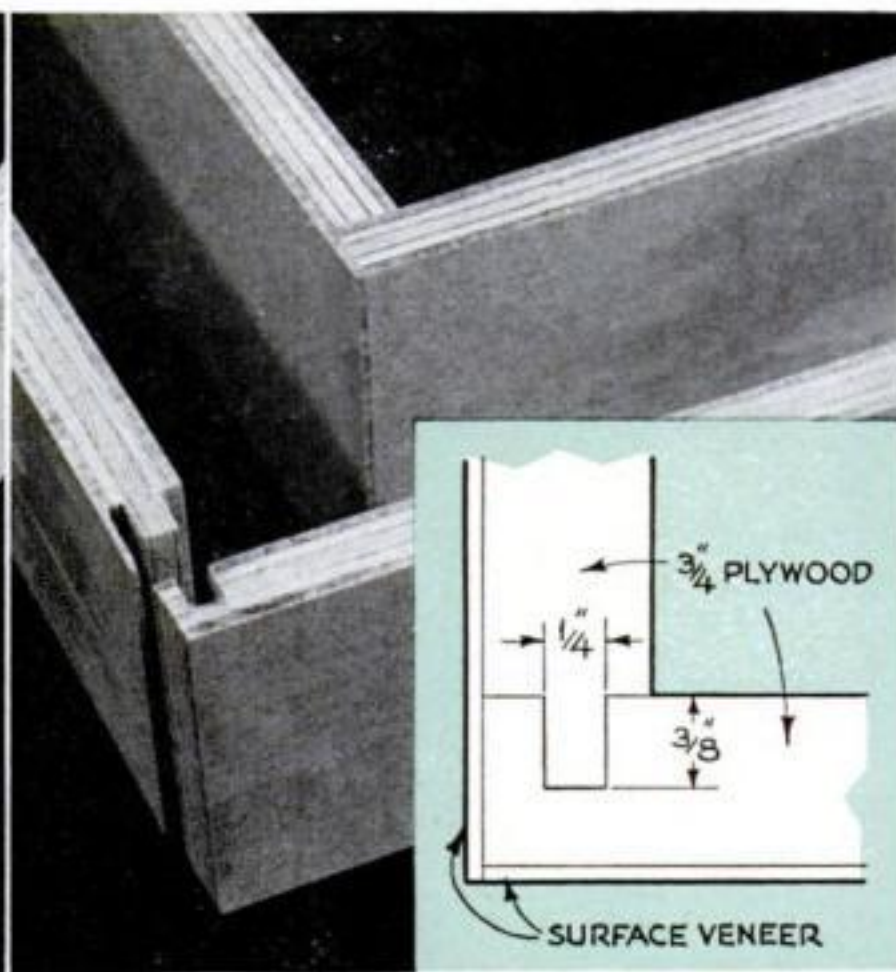


saw so the outer sides of the 45-degree kerfs just touch the plywood edges. This method is not recommended for large panels, which are too difficult to guide through the blade.

3 ways to hide layer-cake edges on corners



SOLID-WOOD INSETS, used with glue-block backing, produce corners that are both distinctive and strong. The insets may be square or triangular, round or cove. Recessed or raised insets will heighten the decorative effect.

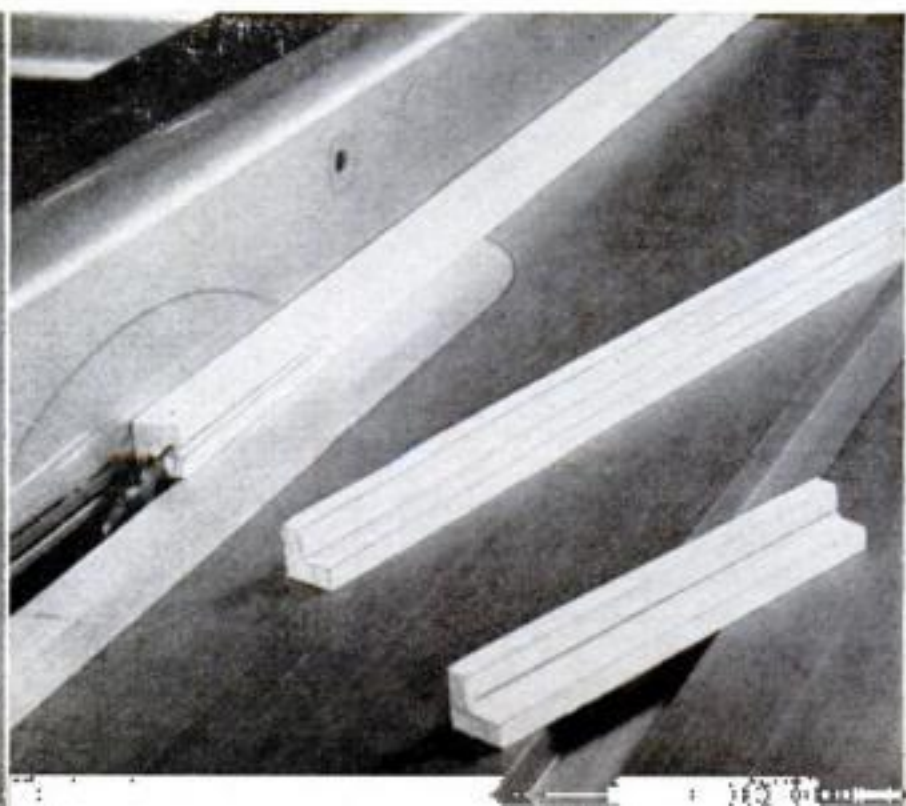
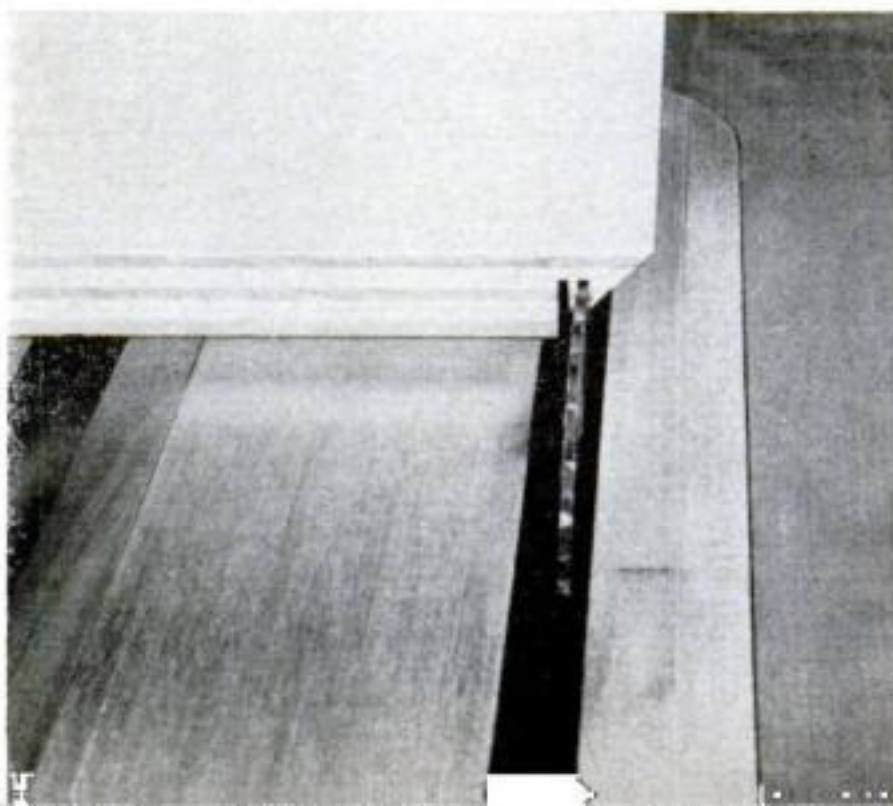


DEEP-RABBIT JOINT (top) leaves only the thin edge of the surface veneer exposed. It's a simple and trim way to finish a corner, but one that produces little structural strength. For a beefed-up job, add a tongue and groove.



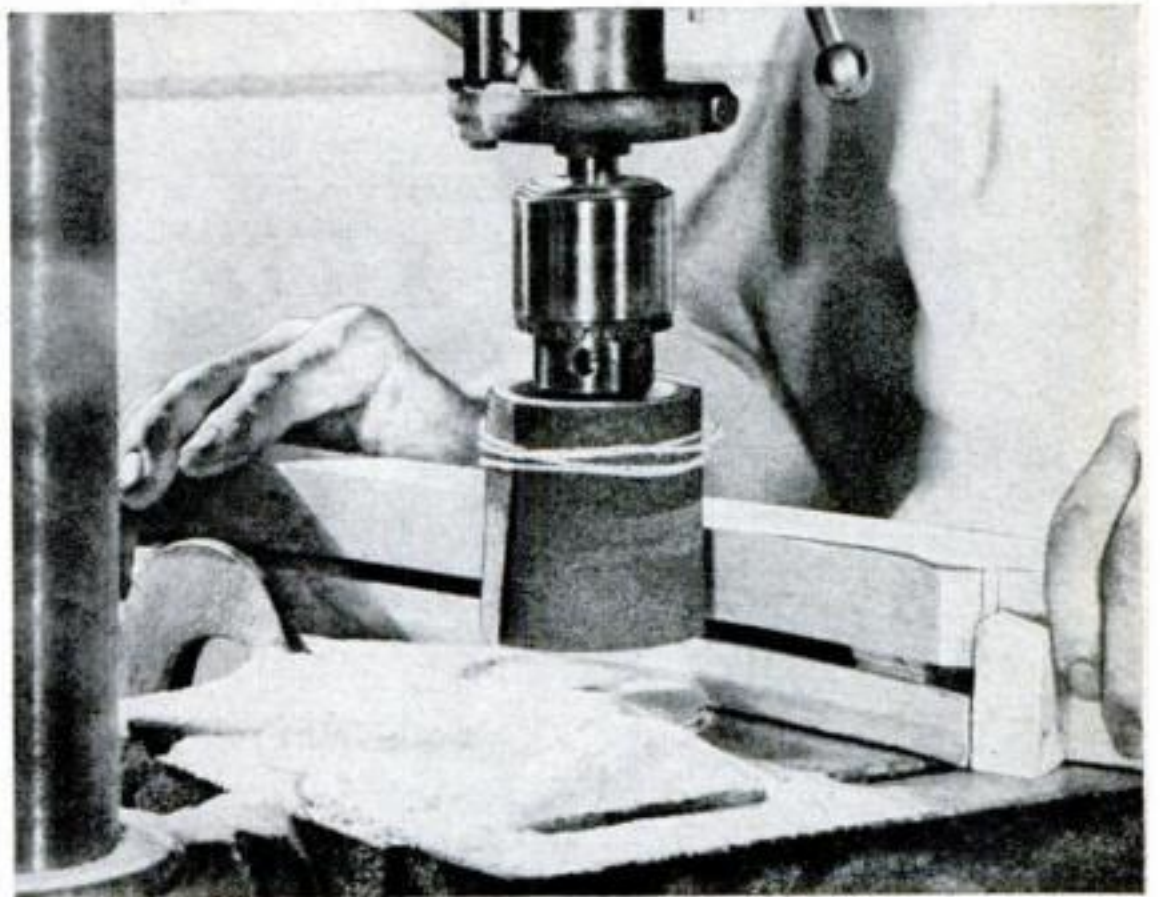
DELUXE, LOCKED-MITER CORNER, shown above, uses an L-shaped spline for accurate alignment and maximum strength. A dado head is useful but not necessary for cutting the 1/4"-wide grooves that take the splines. If you use a regular blade, run off 1/2"-deep kerfs to form the outer edges of each groove. In photo below, at left, note that the inner kerf just touches the

bottom edge of the miter cut. Remove waste stock between the kerfs with additional passes of the saw. Make the splines from 1/2"-square hardwood strips. Adjust the table and rip fence for undercuts that will form an L-shaped cross-section by clearing out a 1/4"-square rabbet. After applying glue, align the mitered edges and drive the splines into place. **END**



The POPULAR SCIENCE Shop Notebook

Sanding-drum sleeves can be improvised in a jiffy from strips of garnet paper, cut three from a standard sheet. Coat the drum with rubber cement and wrap a strip around it with the lap pointing opposite to the direction of rotation. A few turns of twine will tie it in place. Peeling the paper and reapplying it upside down gives a fresh abrasive surface. Almost as effective as a regular sanding sleeve, this makeshift method is cheaper and offers a simple quick-change of grits.—*Edwin Love, Palmdale, Cal.*



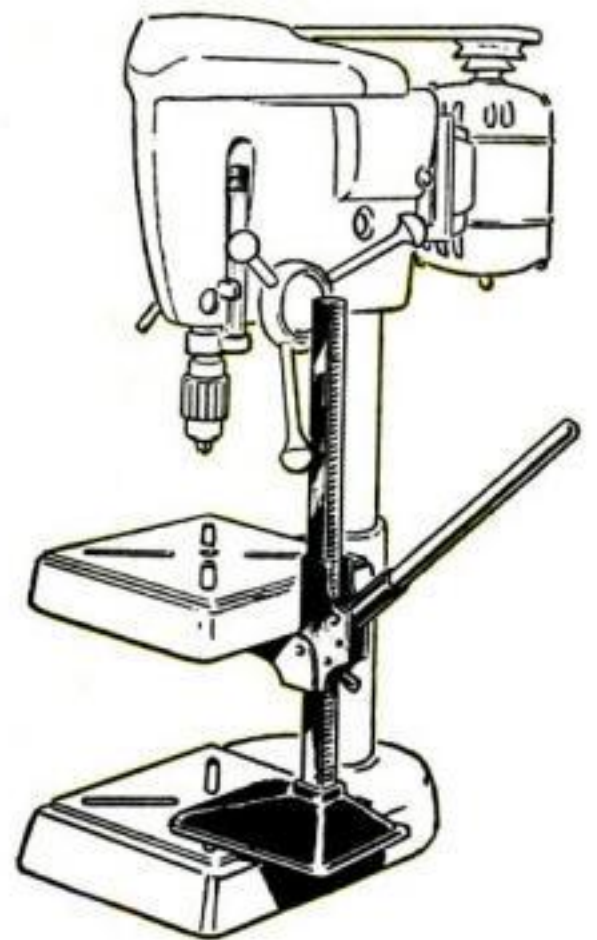
Jack does the work in lifting a drill-press table. The "jack" in this case is the auto-bumper type. It is slow, but enables you to raise the table into position without struggle. Keep the jack close to the column, though, as a precaution to avoid cracking the table casting.—*Rudolph Tomek, Tappan, N. Y.*

Plastic electrician's tape does a better job when it is warm, especially in cold weather. After cutting off a strip, heat it by holding against a light bulb. You will find that the warmth not only makes the tape stickier, but gives it more stretch, which makes it possible to do a more efficient wrap-around job.—*Dave Johnson, Wesleyville, Pa.*

Coffee-can keys can do duty as custom-made drivers for tiny screws. It takes only a little grinding or filing to make them fit into the smallest screw slots.—*James T. Aylward, San Jose, Cal.*

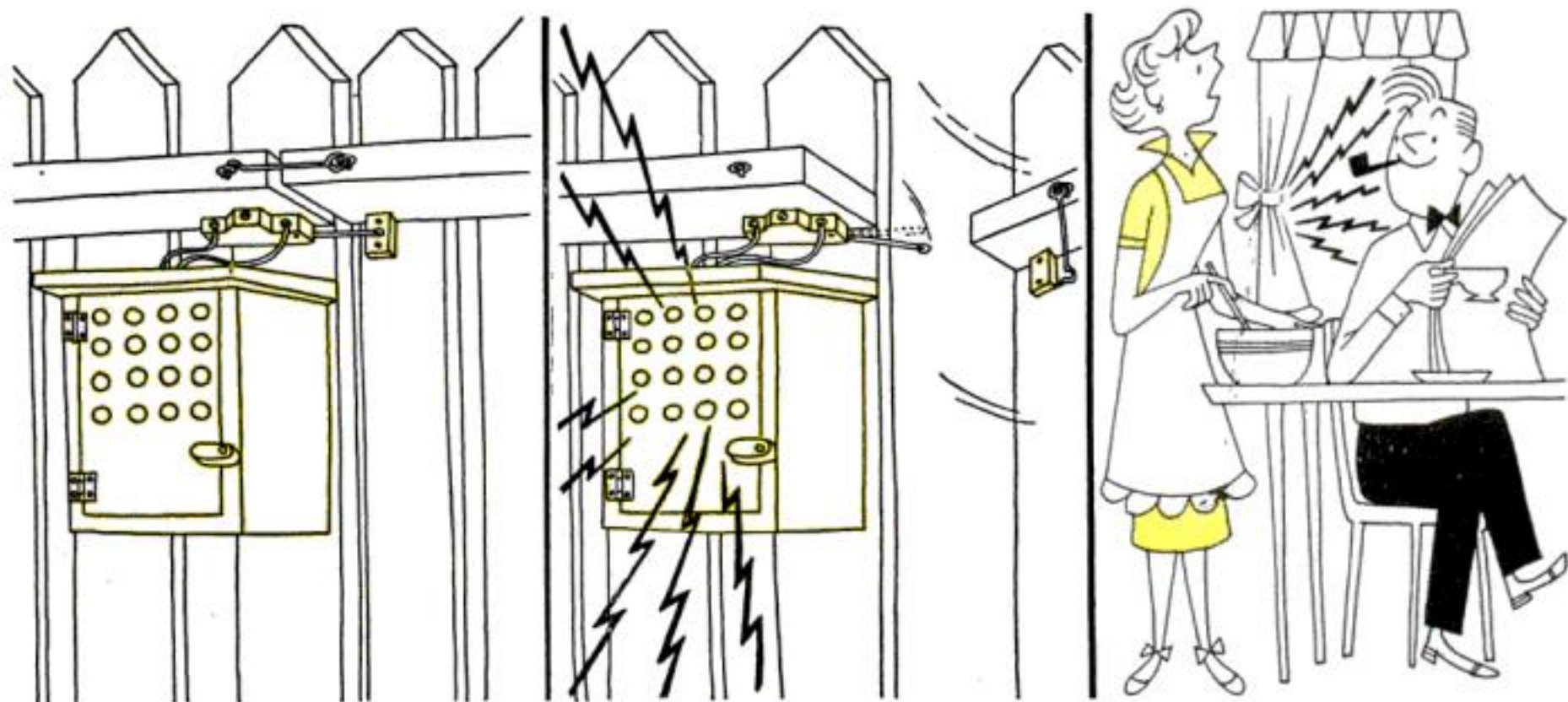
Rolling straightens out a short length of copper wire or tubing. First unkink the piece the best you can with a pair of pliers or your fingers. Then place it on a flat, solid surface, such as a drill-press table, and use a heavy block of metal as a rolling pin.—*Richard Kent, Sherborn, Mass.*

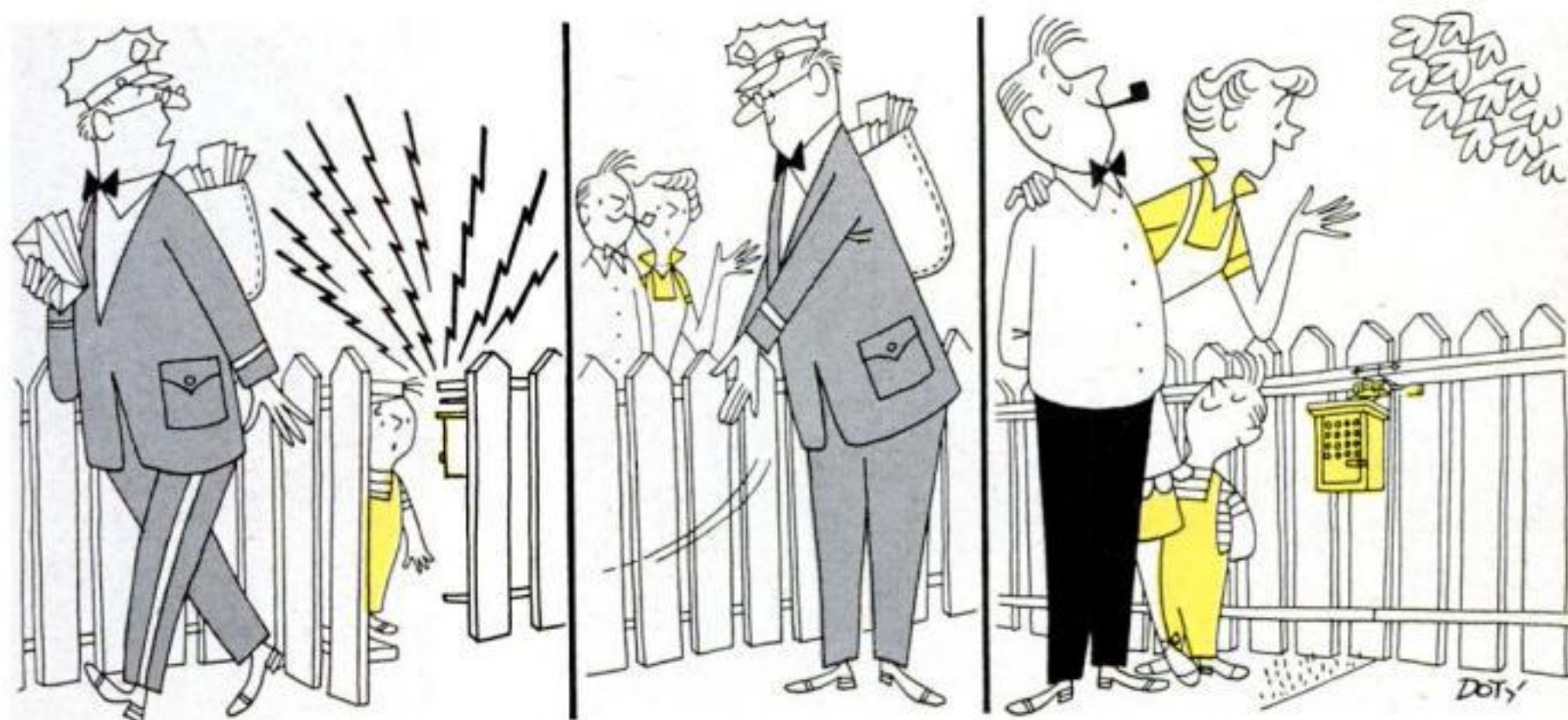
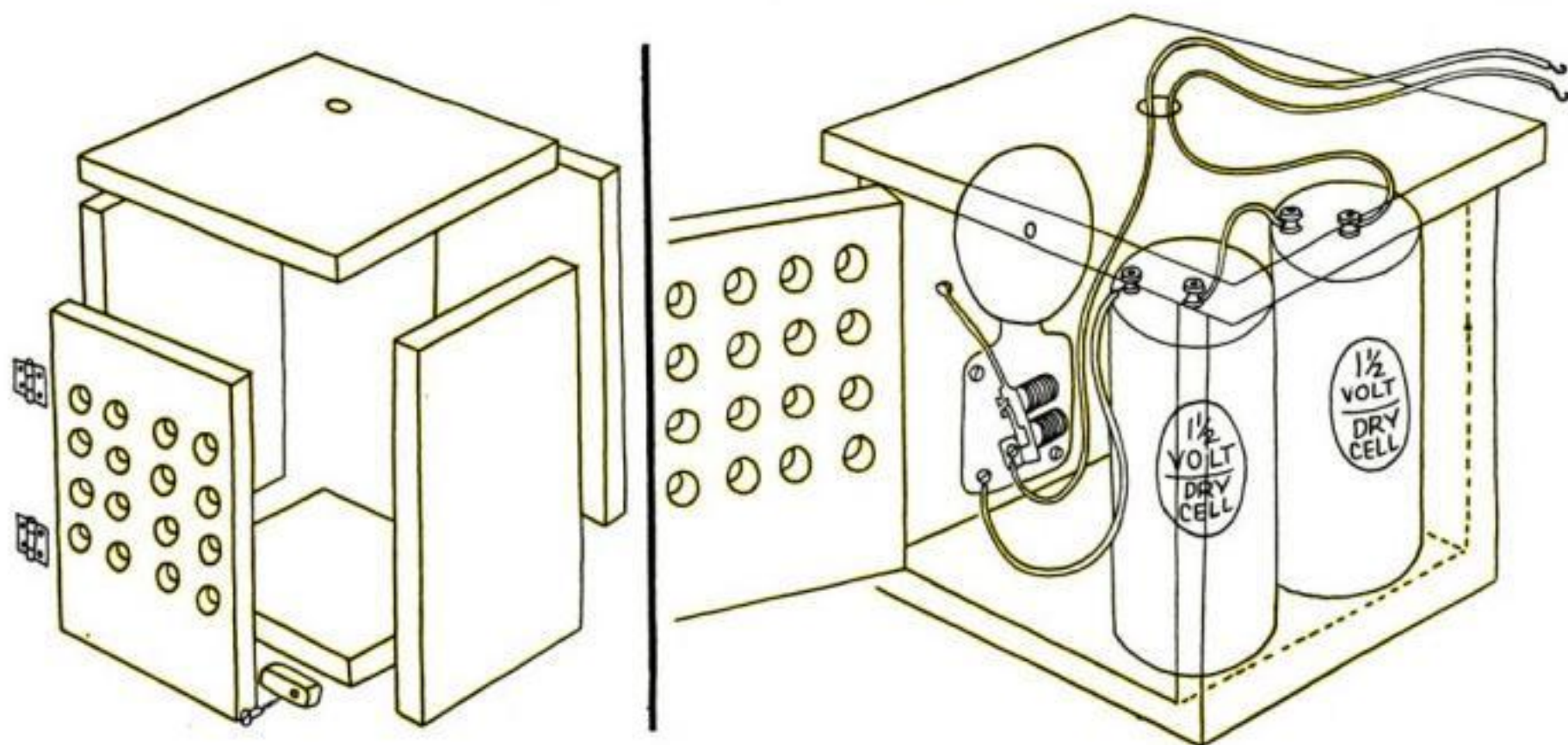
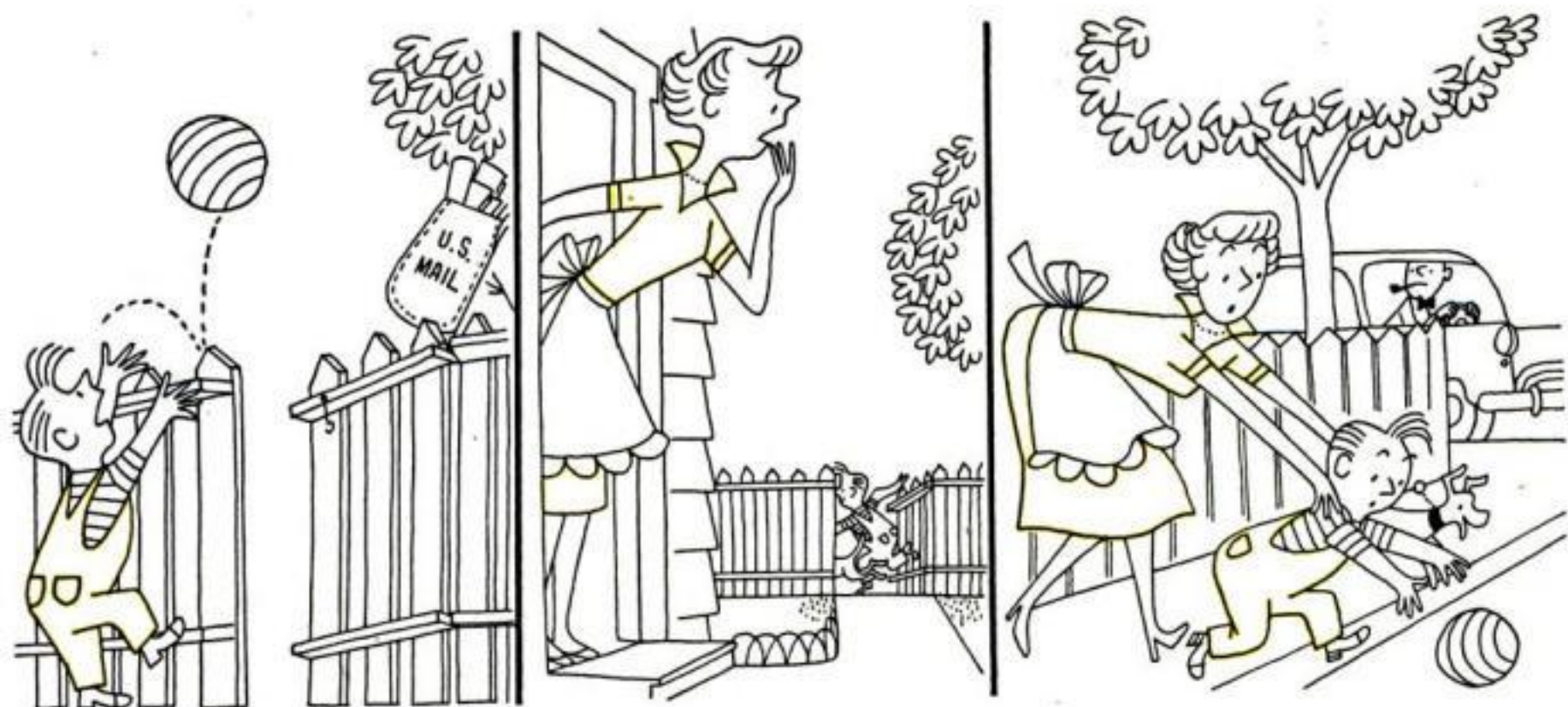
Fingers cut from an old woolen glove and slipped over the jaws of pliers are handy for protecting polished or soft metal surfaces. This way is quicker than wrapping cloth, leather or rubber around the piece you are getting ready to put pressure on.—*William Swallow, Brooklyn, N. Y.*



Wordless Workshop

By Roy Doty
and Herbert R. Pfister





Next Month: A quickly made periscope for parade-watching kids

MAY 1958 149

Ordering a House from the

Put prefabs on your shopping list for a new home. They offer endless variety—and you can pick from a catalogue

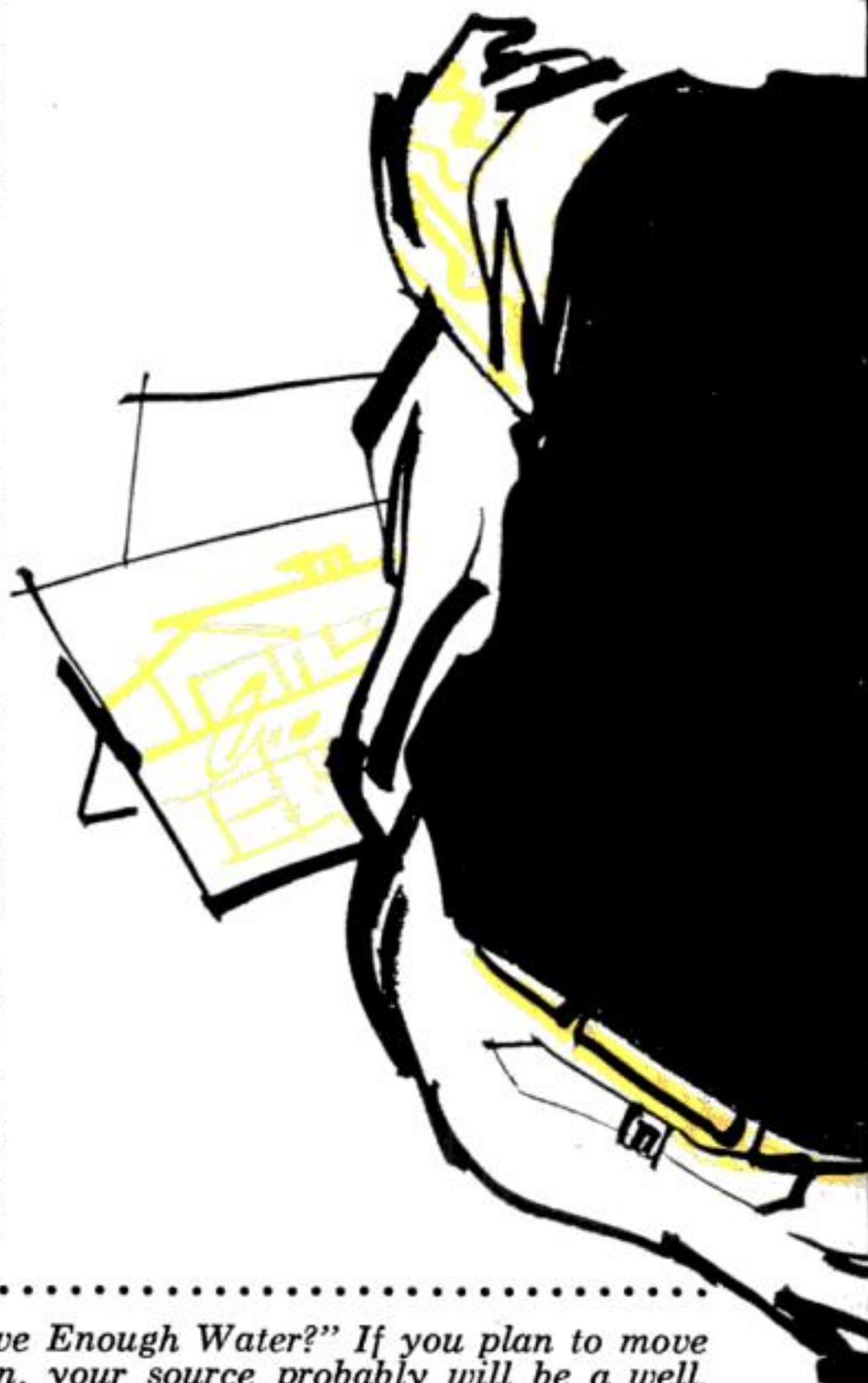
By John L. Springer

ABOUT one of every 10 houses put up in the U. S. this year will be factory built. Next year you can expect even more. Housing experts believe that it won't be long before as many as half of all new housing units will be ordered from catalogues and come off assembly lines.

Prefabs today are not look-alike cheese-boxes. They have individuality. More than 100 manufacturers offer them in thousands of designs for your choice. These range from modest \$5,000, two-bedroom cottages to plush jobs costing more than \$50,000. You can get any style you want—ranch, split-level, two-story colonial, a house designed for a hillside, a house with a basement or without. Inside plans are as varied.

You can have designs by such top-name architects as Frank Lloyd Wright and Royal Barry Wills. Or, if you want to design your own prefab, some manufacturers offer a basic plan. You add here, subtract there, and they supply the components to fit.

The chances are that you have seen and even been in prefabricated houses, perhaps without knowing it, more than likely in a small development of a local dealer-builder who has the agency for one of the prefab manufacturers. Most of these dealer-builders also will put an individual



.....
Next Month: "Will You Have Enough Water?" If you plan to move beyond the local water main, your source probably will be a well. June PS tells you what to look for and how to make your own tests.

BEFORE YOU BUY OR BUILD

Factory



A primer of basic points about factory-built houses

Factory production of house parts and sub-assemblies has advantages for both builder and buyer. Even more points in favor of this modern type of construction seem likely as the fabricators gain experience. One point that surprises many—prefab construction can be just as high in quality as the best custom building. There's no reason for shoddiness.



Built-in stressing of big wall panels and roof sections adds strength to whole house.



Variety of style and plan can be created from basic units to suit your own taste.



House goes up fast. Prefab roof usually can be erected between sunrise and sunset.

prefab on your own land, to your order.

Construction is solid. Some home seekers shy away from prefabs because they associate the idea with cheap construction. Yet they may feel no qualms about buying in a big development where the builder makes his profit by using many of the same mass-production economies as the prefab manufacturers. Prefabs are just as solidly built as the average house, frequently even better. There's a reason.

Most prefab manufacturers build walls in sections 20 to 24 feet long. They use exterior sheathing and interior wallboard that span great distances and give extra bracing strength. The same with roof sections. And these wall and roof sections are built on jigs that don't permit dimensional differences. Wall panels must be square and true in all dimensions. When a house is built on the site, the best of carpenters are bound to slip up now and then.

Prefab sections, on the other hand, don't leave the factory until they have passed a rigid inspection. Perfect fit is inherent in a good prefab house. It *must* fit—and that's pretty good insurance that you'll get seasoned lumber, too.

Local building codes are designed to protect you from jerry-built housing by specifying what size floor joists and roof rafters must be used, how thick a foundation must be, and so on. Prefab builders must abide by the regulations just like other builders.

More for your money. A big prefabber buys the whole output of a lumber mill—at lower prices. Using an assembly line, he can turn out a product cheaper than one put together piece by piece. Besides this, fewer costly man-hours of skilled labor are needed to assemble the structure.

A big prefab offers more chance for saving than a small one. That's because many costs—price of the lot, landscaping, kitchen and bathroom equipment—are about the same whether the house is small or large. In a big house, however, the percentage of money-saving factory-built parts is greater.

There's a wide choice. Suppose you see a house plan you like, but would prefer some changes. Most prefab firms will allow you to make variations so that you wind up with practically a custom-built job. You can change the overall size of the house and the sizes of individual



Prefab techniques offer more dollar savings in a big house than in a small one.



Factory-production of units in jigs makes sure they'll fit tightly when assembled.



Price is not fixed. Labor costs in different parts of the country are a big factor.



When finished, most prefab houses look just like any other. That's your proof of quality.

rooms, change a hip roof to a gabled roof, or move the living room from the right to the left. You can choose from a wide variety of sidings, shingles and color treatments. Usually you can get a choice of basement or no basement, one- or two-car attached garage, carport, or no car storage at all.

Housing in a hurry. Once the builder has his foundation set and the prefab panels and other components are delivered from the factory, he usually can get the roof on in one day. He's not held up by bad weather, and can finish a house quickly. In most cases you can move in six weeks after you sign the contract. A house built in the conventional way may take three months or more to complete.

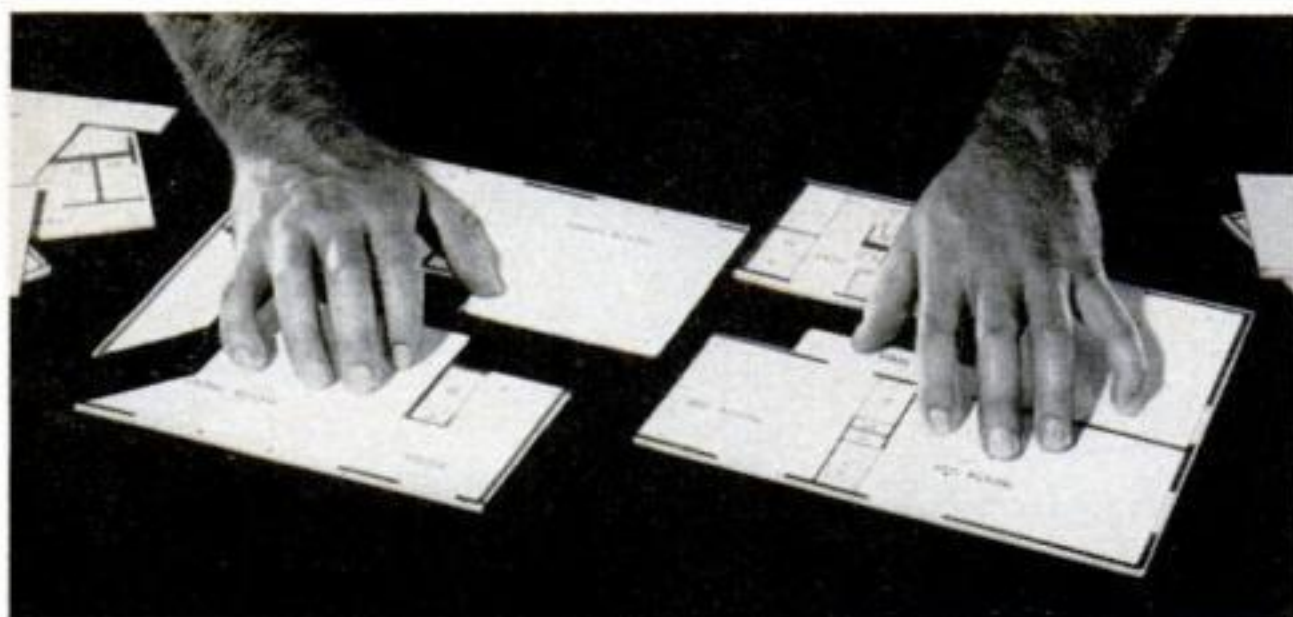
Building the house. The "package" that is delivered from the prefab factory usually consists of exterior walls with windows and doors in place, roof and floor sections, and interior partitions. The builder lays the floor, erects the wall panels, and puts on the roof in a special way in which he has been trained by the factory experts. The rest of the work, such as tiling, installing cabinets, painting, is done as in any other house.

Some manufacturers, such as National Homes, insist that their own builder-dealers do all the structural work. Other manufacturers don't mind if you make a deal to do your own foundation, plumbing, wiring, painting.

For experienced do-it-yourselfers, Place Homes has a special program they call "sweat-equity." Certain work done by the home buyer himself either covers some of his down payment or reduces the basic amount of his home loan.

Financing is no problem. It wasn't so long ago that a conservative banker wouldn't consider underwriting mortgages on prefabs. Today, representatives of many of the country's top banks say they'll lend money on a prefab as readily as on any other house. The bigger prefab manufacturers have taken matters in their own hands. They shop for the best mortgages, and can often offer a better financing deal than a local builder.

Locating a builder. Finding a builder-dealer for a certain make of prefab you are interested in may not be easy. If it weren't that the prefabbers themselves think of "prefabrication" as a naughty word, you might simply look in the classi-



DESIGN YOUR OWN: A selection of templates for five basic interior plans are offered by American Houses. You can juggle these around like a jigsaw puzzle until you come up with the solution — your home. There are also six different exteriors, to provide further variety.

fied phone book. But many of them hide under such headings as “manufactured homes,” “engineered houses,” “pre-assembled homes,” and other chesty titles. If you have trouble, you can get a list of the major manufacturers from the Prefabricated Homes Manufacturers Institute, 1117 Barr Building, Washington 6, D. C. Then, by writing to the manufacturer, you can get the names of dealers near you.

Prices are not firm. If you think factory houses have standard prices like stamps at the post office, you couldn’t be more wrong. Often a house put up by one builder will be priced a full 10 percent below that charged elsewhere. Prices vary from builder to builder and from town to town.

“We cannot control prices from the factory,” one executive explained. “A house in Westchester County, N. Y., will be far more expensive than the same model in Robinson County, N. C., because labor costs vary so much in the two places.”

Getting prices from different dealers on an identical house in the same area is no cinch, either. You’ve got to make sure that they are bidding on the same thing. Some builders include tiled bathrooms, others don’t; some use better grades of material for extras. Some manufacturers do not include plumbing, heating or wiring equipment in their package. In such cases, the local man must supply his own. So one quote you get may include the cheapest fixtures, another top grade.

Local code may boost costs. Building restrictions in your area may prevent prefabbers from using some new cost-cutting materials and methods. Here’s an example: Several house manufacturers have developed utility cores with all the plumbing grouped in a compact unit. This

slashes the cost of assembling and installing the same equipment on a piecemeal basis. But many communities won’t allow such units. Similar restrictions prevent the prefabbers from using industry-approved, but locally prohibited, lower-cost wiring or different-size studs. Prefabs designed to take advantage of these “forbidden” methods may cost more than a conventional house when they have to be modified on site.

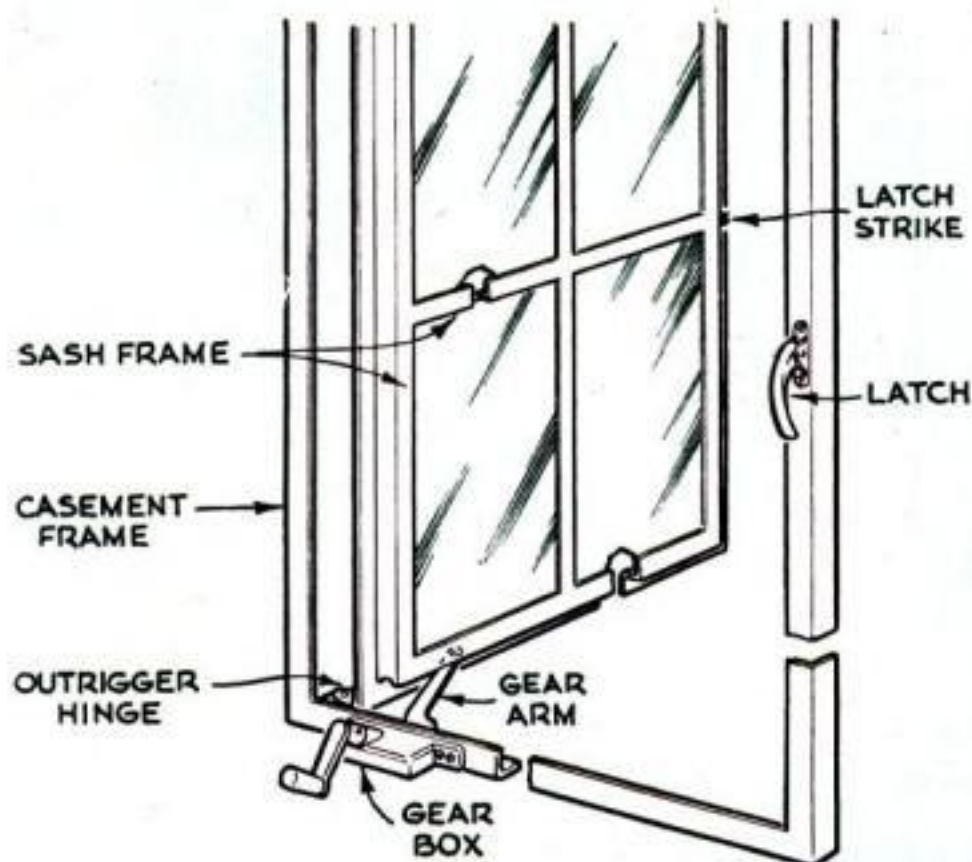
Seeing is not always believing. As in development houses, the selling bait in prefabs probably will be a model, or sample, house. Beware: “All is not gold that glisteneth.” There may be no intent to deceive, but you may be sure that this showcase item has been prettied up and placed to its best advantage. But it’s not the house you’re going to pay for and live with. So check all the specifications. Be sure that you have a complete understanding of exactly what you are going to get, and that it is all in the contract before you sign a purchase order.

Prefab builder-dealers, however, have a reliability factor beyond their own conscience. They can’t take a chance on losing a valuable franchise from the manufacturer. And the manufacturer, guarding his reputation, thoroughly investigates a dealer before signing him up. **END**

Steel casements? Windows of this type last a long time but they do sometimes give trouble. To keep them working right, you’ll want to save the data sheets that follow—along with other pieces for your Fix-it File that appear monthly in **POPULAR SCIENCE**.

Next Month: Faucet sprays.

Popular Science Fix-It File



A STEEL CASEMENT WINDOW will outlast the house if it is periodically maintained. Its worst enemy is rust. A tiny spot can spread unnoticed beneath the paint until, suddenly, the paint flakes off and you're left with a rusty window.

At the first sign of rust, sand and wire-brush the entire frame, protect it with a coat of red lead or rust-resisting paint and finish with a good exterior paint. Avoid straining or damaging the mechanism; keep the window working smoothly. If you must force the crank to open or close it, take this as a sign the window needs attention, and see what's wrong.

To make windows fit tightly . . .

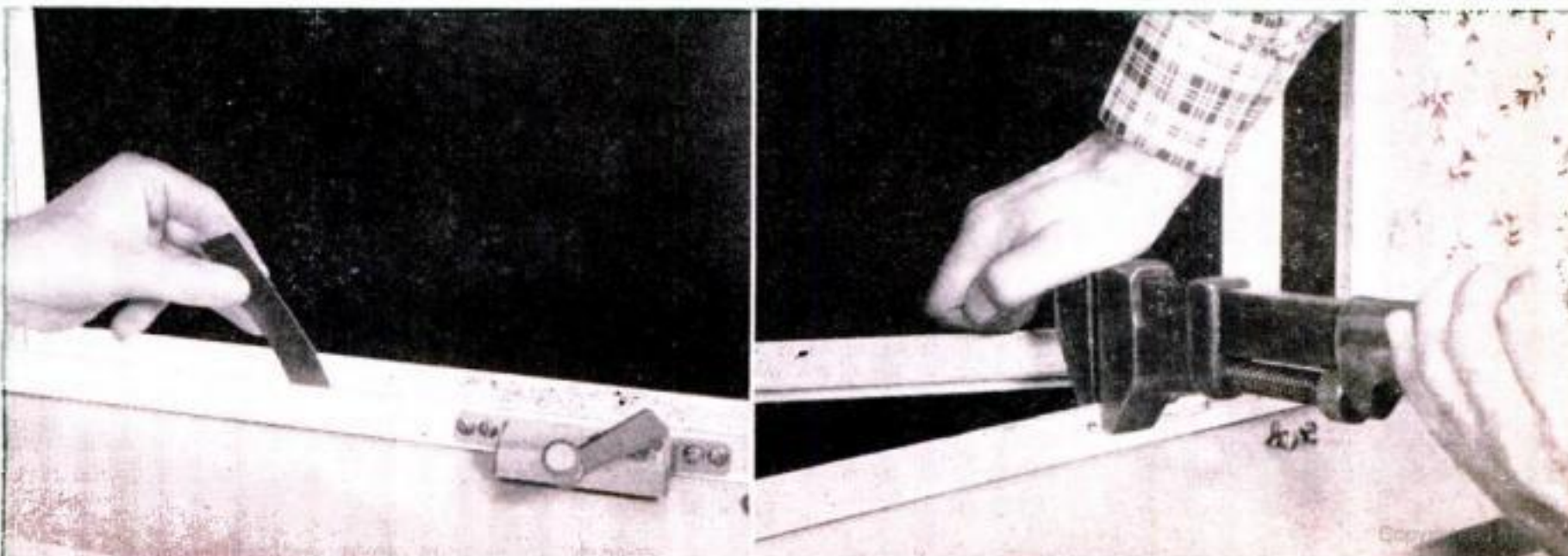


SCRAPE PAINT BLISTERS or rust scales off meeting surfaces of frame and window (left). Adjust strike plate to make the latch pull the window snug against the frame when closed. Oversize screw holes (center) make

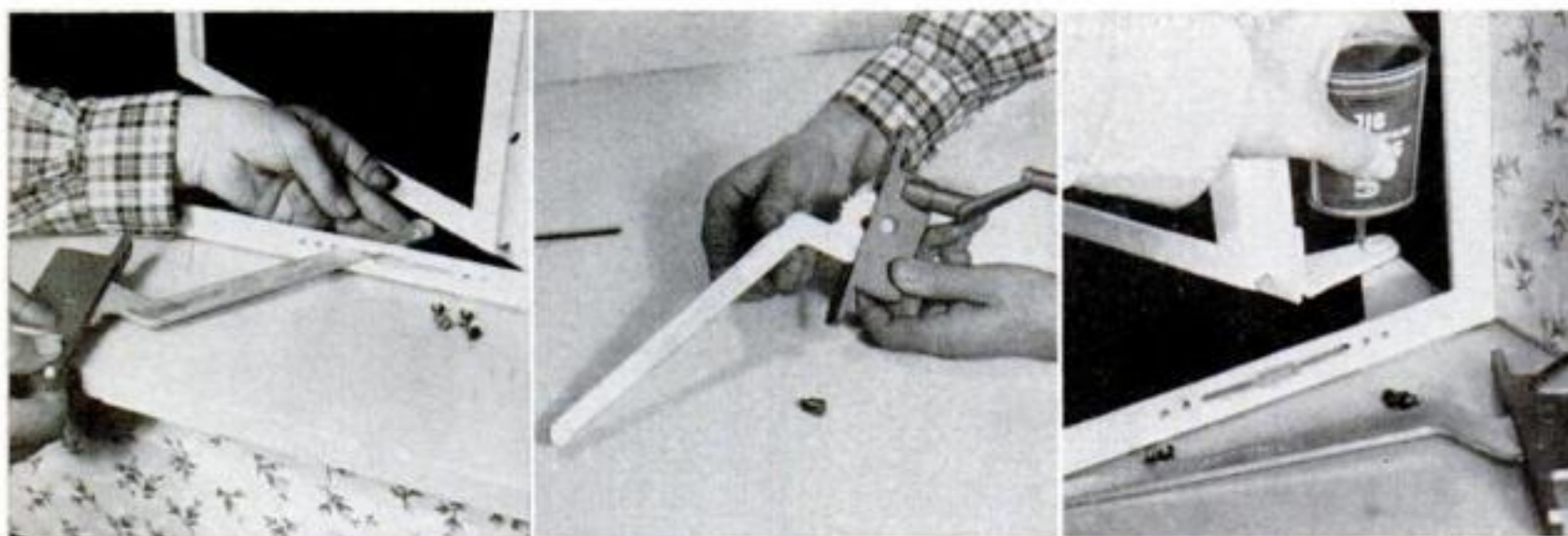
adjustment simple. If this doesn't produce a tight closure, or if the screws are rusted in and can't be loosened, bend the lip of the strike plate inward, as at right, so the latch cam will bring the door in closer.

CHECK FOR SPACES between frame and window with a strip of heavy paper. Condensation sometimes drips down, freezes and expands, bending frame away from the window.

BEND FRAME SLIGHTLY with an adjustable wrench to make it fit snug against the window. Recheck with paper strip until you're sure you have a draft-free enclosure.



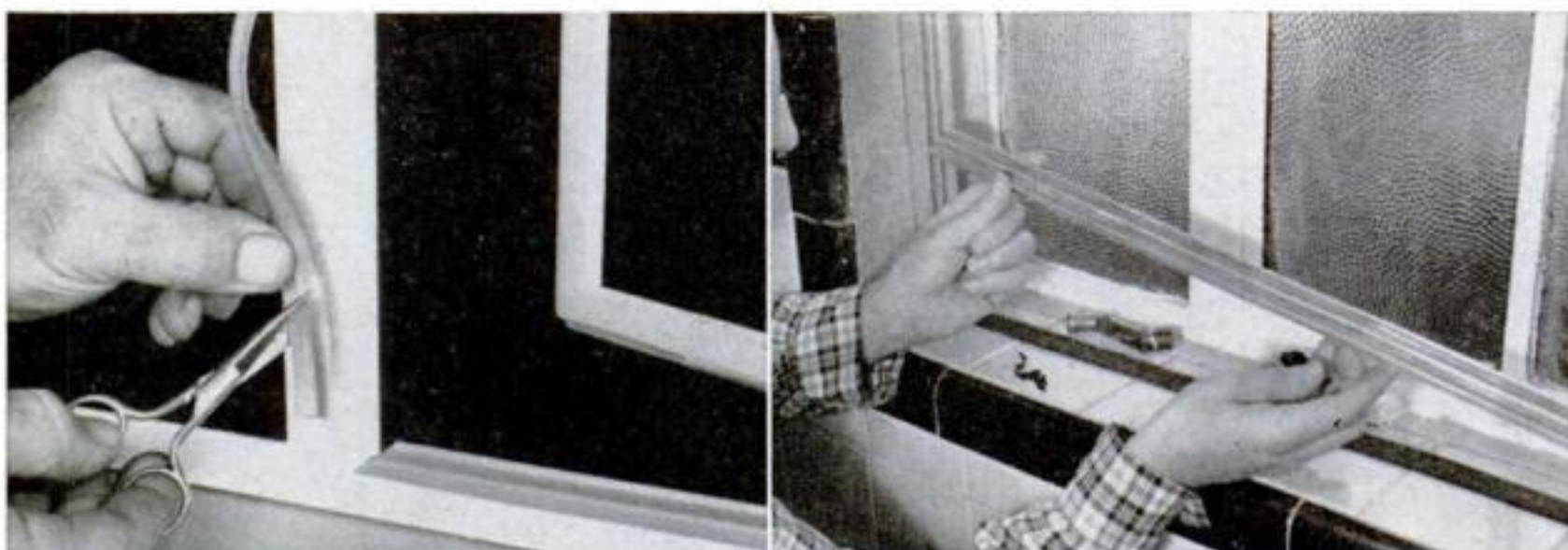
For easy cranking . . .



CLEAN AND LUBRICATE GEAR BOX once a year. Remove screws holding gear box to frame (left photo) and slide the swing-arm out of the window groove. Remove the shouldered screw that holds the gears in mesh (center)

and wash parts in kerosene. Lubricate with heavy motor oil or light grease, and re-assemble. Oil hinge pivots (right) and swing the window in and out to free them. Grease the window groove before replacing arm.

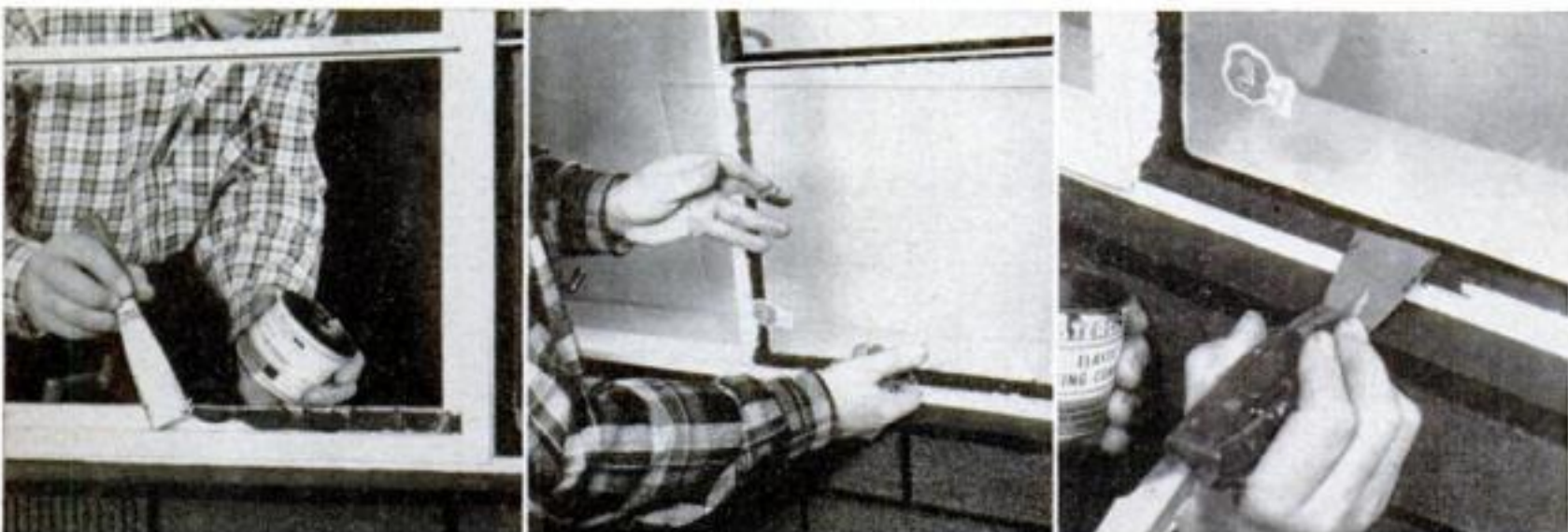
How to seal casement windows



USE THIN PLASTIC WEATHERSTRIPPING to solve metal-to-metal closing problems. Cut strips to length and miter corners to fit frame. Cement the plastic in place with the special vinyl adhesive supplied with it.

INSTALL STORM SASH inside casements. Sash slides in track screwed to sides and top of the window jamb. Bottom track snaps in place between the sides, is removable with windows to keep the sill clear in summer.

How to glaze casements



PREPARE THE SASH FRAME before setting glass in it. Remove rust with sandpaper and paint the metal. Apply a thin, even layer of elastic glazing compound around the frame (left photo). It comes in black or white to match paint. Press the glass firmly in place

(center) and squeeze out any air pockets. Finish by applying the glazing compound outside the glass, smoothing it to a uniform slope with a putty knife (right). Glass for metal casements can be purchased in stock sizes at most hardware stores.

The New Outboards: Complete Facts and Figures

Consumer
News

By John Kingdon

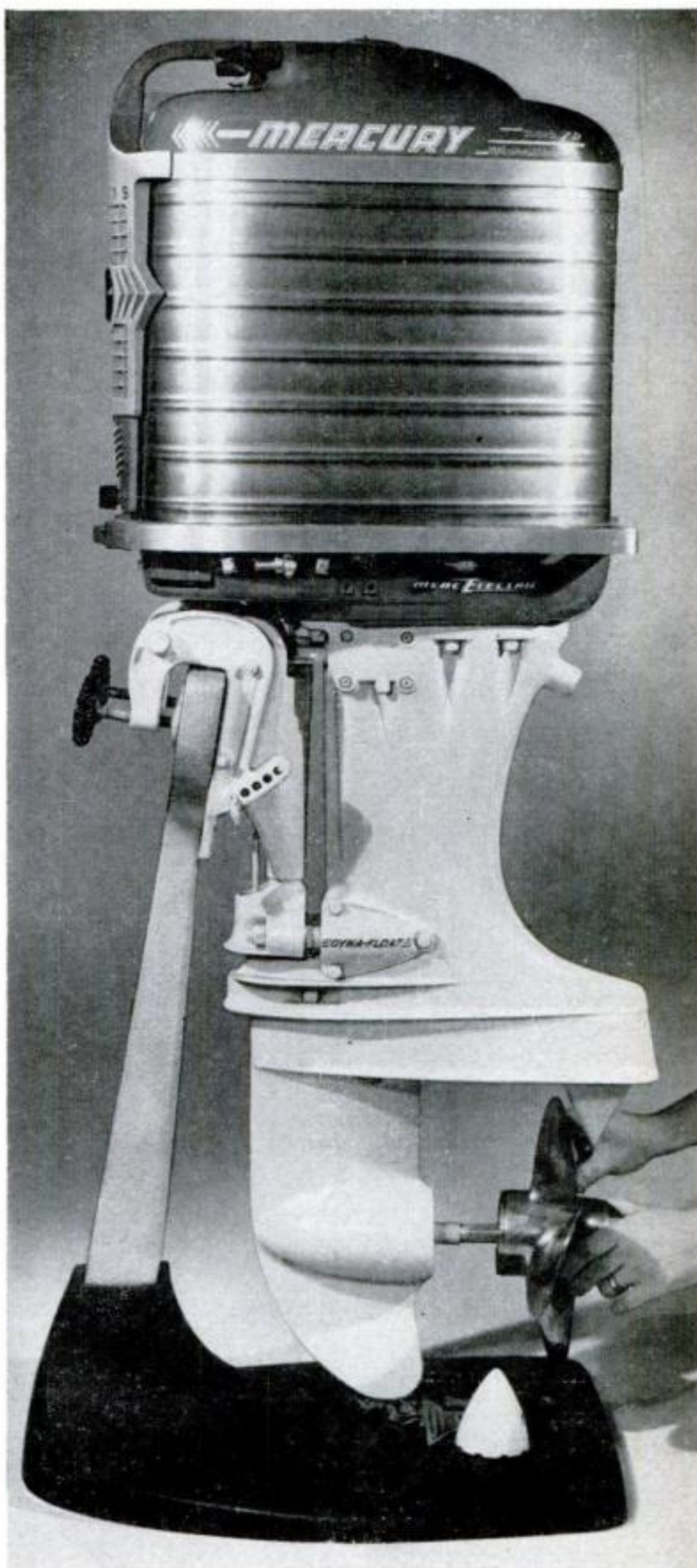
WHILE auto makers have been quietly easing their foot off the horsepower pedal, no such conservatism has come over the outboard boys. Their own private horsepower race, begun only about four years ago, now threatens to break wide open in a glittering array of the most powerful stock engines ever built.

Mercury, which only last year jolted the industry with its 60-hp. motor, is again leading the pack with a staggering new 70-hp. model—most powerful in the business today. Both Johnson and Evinrude have jumped 15 hp. over last year, hiking their top mills to 50 hp. Biggest boost has come from Scott-Atwater, which offers 20 hp. more than last year in a whopping 60-hp. engine for 1958.

Is the end in sight? Not by a long shot, according to such power pioneers as Carl Kiekhaefer, proprietor of the mighty Mercury stable: "Development of larger outboard hulls has long been limited by the lack of adequate horsepower. Thirty-foot outboard boats are now not only feasible, but a reality. We are ready to offer boat owners further substantial horsepower increases as soon as boat development warrants them."

Are higher horsepowers really justified? From many men in the industry the answer is a big

MIGHTIEST MOTOR: New 70-hp. Mercury at right leads outboard race with highest power, yet has lowest weight to hp.—an astonishing 2.5 lb. Total weight is 183 lb. Price: \$960.



yes. The arguments they put forward are persuasive:

- There's more room to expand speed and size on water than on the slickest concrete cow path.

- Unlike autos, boats carry bigger payloads—more people, that is—as they go up in size and power.

- And finally, those who favor large outboards over inboards for their greater

type engines with the highest displacement of all (70.7 cu. in.) to provide their 50 horses.

Why the differences? In the power-hungry, fiercely competitive outboard business, each design represents a different solution to essentially the same problem: high power without the pounding vibration of pistons slamming back and forth. As you add cylinders, you smooth out this vibration by more evenly distributing the power strokes on the crankshaft.

Since all U.S. outboards but one (Fageol) are two-cycle engines with a power stroke every revolution of the crankshaft, their power patterns are identical to four-cycle car engines of twice as many cylinders with a power stroke every *other* revolution of the crankshaft. Thus a three-cylinder outboard is theoretically as smooth as an automotive six, a four as smooth as an eight, a six as smooth as a 12.

Kiekhaefer's fast-stepping 70-hp. Mercury Mark 78 is a product of the lots-of-small-cylinders-instead-of-a-few-big-ones theory. An outgrowth of last year's 60-hp. Mark 75, it stacks six small-bore ($2\frac{9}{16}$ ") cylinders in an in-line row, which Kiekhaefer claims to be the quietest, smoothest-running design going.

His results are impressive: an amazing 1.1 hp. per cubic inch of displacement and the lowest weight per horsepower in the industry—2.5 lb. The engine is tall and slim, permitting twin side-by-side installations with as little as 16" between propeller centers.

Scott-Atwater, also an advocate of the in-line design, has gained an impressive 20 hp. by in effect tacking a third cylinder onto last year's two-cylinder 40-hp. power plant. And while Scott-Atwater doesn't share Kiekhaefer's passion for relatively small cylinders ($3\frac{1}{8}$ " bore to Merc's $2\frac{9}{16}$ "), its engine's weight per horsepower is a very respectable 2.66 lb.—only a shade higher than Merc's.

The counterattack. While the in-line design is admittedly smooth, both Johnson and Evinrude are making a good case for their new four-cylinder, 50-hp. V engines. In-lines, they argue, tend to stretch out the engine block because the cylinders are strung in rows. The V design is compact and the block is rigid.

Chief criticism of the V engine has always been that it is not as inherently well balanced as the in-line (because of the



UNIQUE THREE-CYLINDER DESIGN, first in the U.S. gives this Scott-Atwater a remarkable 60 hp., second only to Merc. At 160 lb., it is the lightest of today's outboard behemoths.

safety and easier handling reply with a simple: "How else can you sling half a hundred horses in the trunk of a car and cart them to the beach for a weekend cruise?"

More horses, but from where? While most motor makers are agreed on heftier horsepowers, they are by no means agreed on where to get them. Result: the most widely diverging engine designs in outboard history.

Mercury gets its 70 horses from six in-line cylinders with a displacement of 66 cu. in. Scott-Atwater, with half as many cylinders and slightly less displacement (63 cu. in.), coaxes out 60 hp. Johnson and Evinrude (both made by Outboard Marine) are pioneering four-cylinder V-

1958 OUTBOARD SPECS		HORSEPOWER (at r.p.m.)	NO. OF CYLINDERS	BORE & STROKE (inches)	DISPLACEMENT (cubic inches)	REVERSE (pivot or gearshift)	STARTING (manual or electric)	FUEL TANK		ENGINE WEIGHT (pounds)	PRICE
MAKE	MODEL							CAPACITY (gallons)	TYPE (integral or remote)		
BUCCANEER	3 Deluxe	3 @ 4,000	1	2-1/8 x 1-1/2	5.32	piv.	man.	0.5	int.	32	\$140.00
	5 Standard	5 @ 4,000	2	1-15/16 x 1-1/2	8.84	piv.	man.	0.8	int.	46.5	\$185.00
	5 Deluxe	5 @ 4,000	2	1-15/16 x 1-1/2	8.84	gear.	man.	4.25	rem.	51	\$230.00
	12 Standard	12 @ 4,000	2	2-1/4 x 2-1/4	17.89	gear.	man.	2	int.	69.5	\$325.00
	12 Deluxe	12 @ 4,000	2	2-1/4 x 2-1/4	17.89	gear.	man.	6	rem.	77.5	\$350.00
	25 Deluxe	25 @ 4,000	2	2-7/8 x 2-3/4	35.7	gear.	man.	6	rem.	119.5	\$465.00
	25 Electric	25 @ 4,000	2	2-7/8 x 2-3/4	35.7	gear.	elec.	6	rem.	130	\$555.00
	35 Electric	35 @ 4,500	2	3-1/16 x 2-3/4	40.5	gear.	elec.	6	rem.	134	\$585.00
ELGIN	5823	2 @ 4,000	1	1-3/4 x 1-9/16	3.76	piv.	man.	0.625	int.	28	\$ 96.95
	5953	5.5 @ 4,000	2	2 x 1-11/16	10.6	gear.	man.	4.25	rem.	56	\$204.95
	5973	7.5 @ 4,000	2	2-1/8 x 1-11/16	11.97	gear.	man.	4.25	rem.	56	\$229.95
	5896	12 @ 4,000	2	2-3/8 x 2	17.72	gear.	man.	6	rem.	61	\$279.95
	25 Electric	25 @ 4,000	2	3 x 2-2/3	37.72	gear.	elec.	6	rem.	118	\$354.95
	5944	35 @ 4,500	2	3-1/8 x 2.706	41.49	gear.	man.	6	rem.	118	\$444.95
	5982	35 @ 4,500	2	3-1/8 x 2.706	41.49	gear.	elec.	6	rem.	130	\$514.95
	5990	35 @ 4,500	2	3-1/8 x 2.706	41.49	gear.	elec.	6	rem.	138	\$554.95
EVINRUDE	Ducktwin	3 @ 4,000	2	1-9/16 x 1-3/8	5.28	piv.	man.	0.61	int.	33	\$160.00
	Lightwin	3 @ 4,000	2	1-9/16 x 1-3/8	5.28	piv.	man.	0.61	int.	33	\$160.00
	Fisherman	5.5 @ 4,000	2	1-15/16 x 1-1/2	8.84	gear.	man.	4.25	rem.	56	\$230.00
	Fleetwin	7.5 @ 4,000	2	2-1/8 x 1-3/4	12.4	gear.	man.	4.25	rem.	59	\$270.00
	Sportwin	10 @ 4,000	2	2-3/8 x 1-7/8	16.6	gear.	man.	6	rem.	68	\$310.00
	Fastwin Std.	18 @ 4,500	2	2-1/2 x 2-1/4	22	gear.	man.	6	rem.	80	\$395.00
	Fastwin Elec.	18 @ 4,500	2	2-1/2 x 2-1/4	22	gear.	elec.	6	rem.	87	\$475.00
	Big Twin Std.	35 @ 4,500	2	3-1/16 x 2-3/4	40.5	gear.	man.	6	rem.	123	\$495.00
	Big Twin Elec.	35 @ 4,500	2	3-1/16 x 2-3/4	40.5	gear.	elec.	6	rem.	129	\$585.00
	Lark	35 @ 4,500	2	3-1/16 x 2-3/4	40.5	gear.	elec.	6	rem.	138	\$625.00
	Four-Fifty	50 @ 4,000	V-4	3 x 2-1/2	70.7	gear.	man.	6	rem.	197	\$740.00
	Starflite	50 @ 4,000	V-4	3 x 2-1/2	70.7	gear.	elec.	6	rem.	205	\$840.00
FAGEOL	"44"	35 @ 5,200	4	2-1/2 x 2-1/4	44	gear.	elec.	6.2	rem.	190	\$867.00
FIRESTONE	3.6	3.6 @ 4,000	1	2-1/8 x 1-3/4	6.21	none	man.	1	int.	36	\$125.00
	5	5 @ 4,200	2	1-11/16 x 1-43/64	7.48	gear.	man.	3.5	rem.	42	\$225.00
	10	10 @ 4,200	2	2-11/64 x 2	14.82	gear.	man.	6	rem.	59	\$320.00
	16	16 @ 4,200	2	2-11/32 x 2-5/16	19.95	gear.	man.	6	rem.	68	\$365.00
	38	38 @ 4,800	2	3-1/16 x 2-3/4	40.51	gear.	man.	6	rem.	117	\$499.95
	38	38 @ 4,800	2	3-1/16 x 2-3/4	40.51	gear.	elec.	6	rem.	125	\$599.95
HIAWATHA	3.6	3.6 @ 4,000	1	2-1/8 x 1-3/4	6.21	none	man.	1	int.	36	\$109.95
	5	5 @ 4,200	2	1-11/16 x 1-43/64	7.48	gear.	man.	3.5	rem.	45	\$209.95
	7.5	7.5 @ 4,200	2	2 x 1-3/4	11	gear.	man.	6	rem.	59	\$239.95
	10	10 @ 4,200	2	2-11/64 x 2	14.82	gear.	man.	6	rem.	66	\$319.95
	16	16 @ 4,200	2	2-11/32 x 2-5/16	19.95	gear.	man.	6	rem.	79	\$349.95
	38	38 @ 4,800	2	3-1/16 x 2-3/4	40.51	gear.	man.	6	rem.	128	\$509.95
	38	38 @ 4,800	2	3-1/16 x 2-3/4	40.51	gear.	elec.	6	rem.	137	\$609.95
JOHNSON	Sea-Horse 3	3 @ 4,000	2	1-9/16 x 1-3/8	5.28	piv.	man.	0.61	int.	33.25	\$160.00
	Sea-Horse 5-1/2	5.5 @ 4,000	2	1-15/16 x 1-1/2	8.84	gear.	man.	4.5	rem.	56	\$230.00
	Sea-Horse 7-1/2	7.5 @ 4,000	2	2-1/8 x 1-3/4	12.4	gear.	man.	4.5	rem.	59	\$270.00
	Sea-Horse 10	10 @ 4,000	2	2-3/8 x 1-7/8	16.6	gear.	man.	6	rem.	67	\$310.00
	Sea-Horse 18	18 @ 4,500	2	2-1/2 x 2-1/4	22	gear.	man.	6	rem.	77	\$395.00
	Sea-Horse 18	18 @ 4,500	2	2-1/2 x 2-1/4	22	gear.	elec.	6	rem.	87	\$475.00
	Sea-Horse 35	35 @ 4,500	2	3-1/16 x 2-3/4	40.5	gear.	man.	6	rem.	123	\$495.00
	Sea-Horse 35	35 @ 4,500	2	3-1/16 x 2-3/4	40.5	gear.	elec.	6	rem.	129	\$585.00
	Super										
	Sea-Horse 35	35 @ 4,500	2	3-1/16 x 2-3/4	40.5	gear.	elec.	6	rem.	138	\$625.00
	Sea-Horse 50	50 @ 4,000	V-4	3 x 2-1/2	70.7	gear.	man.	6	rem.	197	\$740.00
	Super										
	Sea-Horse 50	50 @ 4,000	V-4	3 x 2-1/2	70.7	gear.	elec.	6	rem.	205	\$840.00
MERCURY	Mark 6	6	2	1-3/4 x 1-1/2	7.2	piv.	man.	3.25	rem.	42	\$225.00
	Mark 10	10	2	2-11/32 x 2-1/8	18.5	gear.	man.	6	rem.	66	\$330.00
	Mark 25	20	2	2-7/16 x 2-1/8	20	gear.	man.	6	rem.	75	\$380.00
	Mark 28	22	2	2-9/16 x 2-1/8	22	gear.	man.	6	rem.	79	\$430.00
	Mark 30	30	4	2-7/64 x 2-1/8	30	gear.	man.	6	rem.	110	\$479.00
	Mark 30H	30	4	2-7/64 x 2-1/8	30	gear.	man.	6	rem.	105	\$540.00*
	Mark 55M	40	4	2-7/16 x 2-1/8	40	gear.	man.	6	rem.	111	\$535.00*
	Mark 55S	40	4	2-7/16 x 2-1/8	40	gear.	elec.	6	rem.	116	\$585.00*
	Mark 55E	40	4	2-7/16 x 2-1/8	40	gear.	elec.	6	rem.	120	\$655.00*
	Mark 55H	40	4	2-7/16 x 2-1/8	40	gear.	man.	6	rem.	109	\$643.00*
	Mark 55L	40	4	2-7/16 x 2-1/8	40	gear.	man.	6	rem.	114	\$565.00*
	Mark 55EL	40	4	2-7/16 x 2-1/8	40	gear.	elec.	6	rem.	123	\$685.00*
	Mark 58M	45	4	2-9/16 x 2-1/8	44	gear.	man.	6	rem.	122	\$630.00*
	Mark 58S	45	4	2-9/16 x 2-1/8	44	gear.	elec.	6	rem.	127	\$680.00*
	Mark 58E	45	4	2-9/16 x 2-1/8	44	gear.	elec.	6	rem.	131	\$750.00*
	Mark 58EL	45	4	2-9/16 x 2-1/8	44	gear.	elec.	6	rem.	134	\$780.00*
	Mark 75M	60	6	2-7/16 x 2-1/8	60	gear.	man.	6	rem.	152	\$730.00*
	Mark 75S	60	6	2-7/16 x 2-1/8	60	gear.	elec.	6	rem.	164	\$780.00*
	Mark 75E	60	6	2-7/16 x 2-1/8	60	direct	elec.	6	rem.	168	\$850.00*
	Mark 75EL	60	6	2-7/16 x 2-1/8	60	reverse	elec.	6	rem.	171	\$880.00*
	Mark 78E	70	6	2-9/16 x 2-1/8	66		elec.	6	rem.	180	\$960.00*
	Mark 78EL	70	6	2-9/16 x 2-1/8	66		elec.	6	rem.	183	\$960.00*

*Price does not include propeller.

Chart continued on next page

1958 OUTBOARD SPECS		HORSEPOWER (at r.p.m.)	NO. OF CYLINDERS	BORE & STROKE (inches)	DISPLACEMENT (cubic inches)	REVERSE (pivot or gearshift)	STARTING (manual or electric)	FUEL TANK		ENGINE WEIGHT (pounds)	PRICE
MAKE	MODEL							CAPACITY (gallons)	TYPE (integral or remote)		
NEPTUNE	Mighty Mite	1.7 @ 4,000	1	1-9/16 x 1-1/2	2.94	none	man.	0.25	int.	17	\$ 89.50
OLIVER	6	6 @ 4,500	2	2 x 1-1/2	9.42	gear.	man.	3.5	rem.	50	\$235.00
	16	16 @ 4,500	2	2-1/2 x 2-1/32	19.94	gear.	man.	6	rem.	79	\$385.00
	16	16 @ 4,500	2	2-1/2 x 2-1/32	19.94	gear.	elec.	6	rem.	79	\$475.00
	35	35 @ 4,500	2	3-1/16 x 2-7/8	42.35	gear.	elec.	6	rem.	125	\$642.00
SCOTT-ATWATER	Scotty	3.6 @ 4,000	1	2-1/8 x 1-3/4	6.23	none	man.	1	int.	36	\$134.00
	Thrifty Scott	5 @ 4,200	2	1-11/16 x 1-43/64	7.48	gear.	man.	3.5	rem.	50	\$242.75
	Fishing Scott	7.5 @ 4,200	2	2 x 1-3/4	11	gear.	man.	6	rem.	60	\$277.25
	Family Scott	10 @ 4,200	2	2-11/64 x 2	14.82	gear.	man.	6	rem.	65	\$324.50
	Special Scott	16 @ 4,200	2	2-11/32 x 2-5/16	19.95	gear.	man.	6	rem.	80	\$384.25
	Sports Scott	22 @ 4,800	2	2-11/16 x 2-7/16	27.65	gear.	man.	6	rem.	107	\$448.50
	Sports Scott	22 @ 4,800	2	2-11/16 x 2-7/16	27.65	gear.	elec.	6	rem.	119	\$563.50
	Super Scott	40 @ 4,800	2	3-1/8 x 2-3/4	42.18	gear.	man.	6	rem.	130	\$538.50
	Super Scott	40 @ 4,800	2	3-1/8 x 2-3/4	42.18	gear.	elec.	6	rem.	142	\$663.00
	Royal Scott	40 @ 4,800	2	3-1/8 x 2-3/4	42.18	gear.	elec.	6	rem.	142	\$749.00
	Flying Scott	60 @ 4,800	3	3-1/8 x 2-3/4	63.27	gear.	elec.	6	rem.	160	\$979.50
SEA BEE	3 Deluxe	3 @ 4,000	1	2-1/8 x 1-1/2	5.32	piv.	man.	0.5	int.	32	\$135.95
	5 Standard	5 @ 4,000	2	1-15/16 x 1-1/2	8.84	piv.	man.	0.8	int.	46	\$183.50
	5 Deluxe	5 @ 4,000	2	1-5/16 x 1-1/2	8.84	gear.	man.	1	int.	52	\$216.95
	12 Deluxe	12 @ 4,000	2	2-1/4 x 2-1/4	17.89	gear.	man.	6	rem.	77	\$361.95
	25 Deluxe	25 @ 4,000	2	2-7/8 x 2-3/4	35.7	gear.	man.	6	rem.	119	\$466.95
SEA KING	3 Deluxe	3 @ 4,000	1	2-1/8 x 1-1/2	5.32	piv.	man.	0.5	int.	32	\$117.00
	5 Deluxe	5 @ 4,000	2	1-15/16 x 1-1/2	8.84	gear.	man.	1	int.	52	\$186.00
	12 Deluxe	12 @ 4,000	2	2-1/4 x 2-1/4	17.89	gear.	elec.	6	rem.	77.5	\$309.00
	25 Deluxe	25 @ 4,000	2	2-7/8 x 2-3/4	35.7	gear.	elec.	6	rem.	119	\$414.00
	35 Twin	35 @ 4,500	2	3-1/6 x 2-3/4	40.5	gear.	elec.	6	rem.	134	\$585.00
SPORT	Standard	2.5 @ 4,200	1	1-5/8 x 1-5/8	3.46	piv.	man.	0.625	int.	22	\$ 89.95
	Deluxe	2.5 @ 4,200	1	1-5/8 x 1-5/8	3.46	piv.	man.	0.625	int.	22	\$ 99.95
WEST BEND	Shrimp	2 @ 4,000	1	1-3/4 x 1-9/16	3.76	piv.	man.	0.625	int.	28	\$119.95
	Pike	6 @ 4,500	2	2 x 1-11/16	10.60	gear.	man.	4.5	rem.	56	\$249.95
	Muskie	8 @ 4,500	2	2-1/8 x 1-11/16	11.97	gear.	man.	4.5	rem.	57	\$275.00
	Barracuda	12 @ 4,000	2	2-3/8 x 2	17.72	gear.	man.	6	rem.	59	\$349.95
	Shark	35 @ 4,500	2	3-1/8 x 2.706	41.49	gear.	man.	6	rem.	118	\$495.00
	Shark	35 @ 4,500	2	3-1/8 x 2.706	41.49	gear.	elec.	6	rem.	132	\$585.00
	Shark	35 @ 4,500	2	3-1/8 x 2.706	41.49	gear.	elec.	6	rem.	136.5	\$615.00
	Shark	35 @ 4,500	2	3-1/8 x 2.706	41.49	gear.	elec.	6	rem.	142	\$635.00
WIZARD	5-1/2	5.5 @ 4,200	2	2 x 1-1/2	9.42	gear.	man.	3.5	rem.	55	\$210.00
	Powermatic 15	15 @ 4,200	2	2-1/2 x 2-1/32	19.94	gear.	man.	6	rem.	75	\$339.50
	Powermatic 35	35 @ 4,500	2	3-1/16 x 2-7/8	42.35	gear.	man.	6.5	rem.	125	\$495.00
	Powermatic 35	35 @ 4,500	2	3-1/16 x 2-7/8	42.35	gear.	elec.	6.5	rem.	125	\$595.00

Who's who in the outboard race

On this and the previous page are listed specifications for U. S. outboards by brand name. In order to tell who makes and distributes each brand, here's how they stack up:

Buccaneer: Gale Products, Galesburg, Ill., a division of Outboard Marine Corp.

Elgin: Made by West Bend Aluminum Co., Hartford, Wis. Distributed by Sears, Roebuck and Co., Chicago.

Evinrude: Evinrude Motors, Milwaukee, a division of Outboard Marine Corp.

Fageol: Fageol Marine Engine Co., San Diego, Cal.

Firestone: Made by Scott-Atwater Mfg. Co., Minneapolis 13. Distributed by Firestone Tire & Rubber Co., 1200 Firestone Pkwy., Akron 17, Ohio.

Hiawatha: Made by Scott-Atwater Mfg. Co., Minneapolis 13. Distributed by Gamble-Skogmo stores.

Johnson: Johnson Motors, Waukegan, Ill., a division of Outboard Marine Corp.

Mercury: Kiekhaefer Corp., Fond du Lac, Wis.

Neptune: Muncie Gear Works, Inc., Muncie, Ind.

Oliver: The Oliver Corp., 108 S. McCamly St., Battle Creek, Mich.

Scott-Atwater: Scott-Atwater Mfg. Co., Minneapolis 13.

Sea Bee: Made by Gale Products, Galesburg, Ill., a division of Outboard Marine Corp. Distributed by Goodyear Tire & Rubber Co., Inc., 1144 E. Market St., Akron, Ohio.

Sea King: Made by Gale Products, Galesburg, Ill., a division of Outboard Marine Corp. Distributed by Montgomery Ward, Chicago.

Sport: Comanco, Inc., Washington Blvd. at Motor Ave., Culver City, Cal.

West Bend: West Bend Aluminum Co., Hartford, Wis.

Wizard: Made by The Oliver Corp., 108 S. McCamly St., Battle Creek, Mich. Distributed by Western Auto Supply Co., 2107 Grand Ave., Kansas City 8, Mo.

angular placement of the cylinders). Both Johnson and Evinrude claim to have solved this problem, like Detroit, by adding counterweights to the crankshaft that offset the unbalancing forces. Their V-4s are thus as smooth-running as an automotive eight.

More glitter. Hand in hand with higher power has also come higher styling and the greatest array of convenience gadgetry since Detroit made the crank handle obsolete. Most top engines either come with electric starting or offer it as optional equipment.

Scott-Atwater's 60-hp. Flying Scott may be as close as you'll ever get to automotive convenience. Its battery-generator electrical system, which eliminates the old spin-it-yourself magneto, is similar to that of Johnson, Evinrude and Mercury, but also has an honest-to-goodness automotive-type voltage regulator. A dashboard panel has a key-type starter switch and two lights, one to signal battery discharge and the other to warn of overheating. With an added accessory, you can flip a switch on the dash and raise or lower the motor electro-hydraulically for launching, beaching or running through shallow water.

The Flying Scott's fuel system has a separate carburetor for each cylinder. At low and medium speeds, each cylinder draws from its own carburetor only, but at full throttle a new type of balance-tube manifold allows each cylinder to draw on all three carburetors. This is said to give the motor the widest range of breathing flexibility of any outboard.

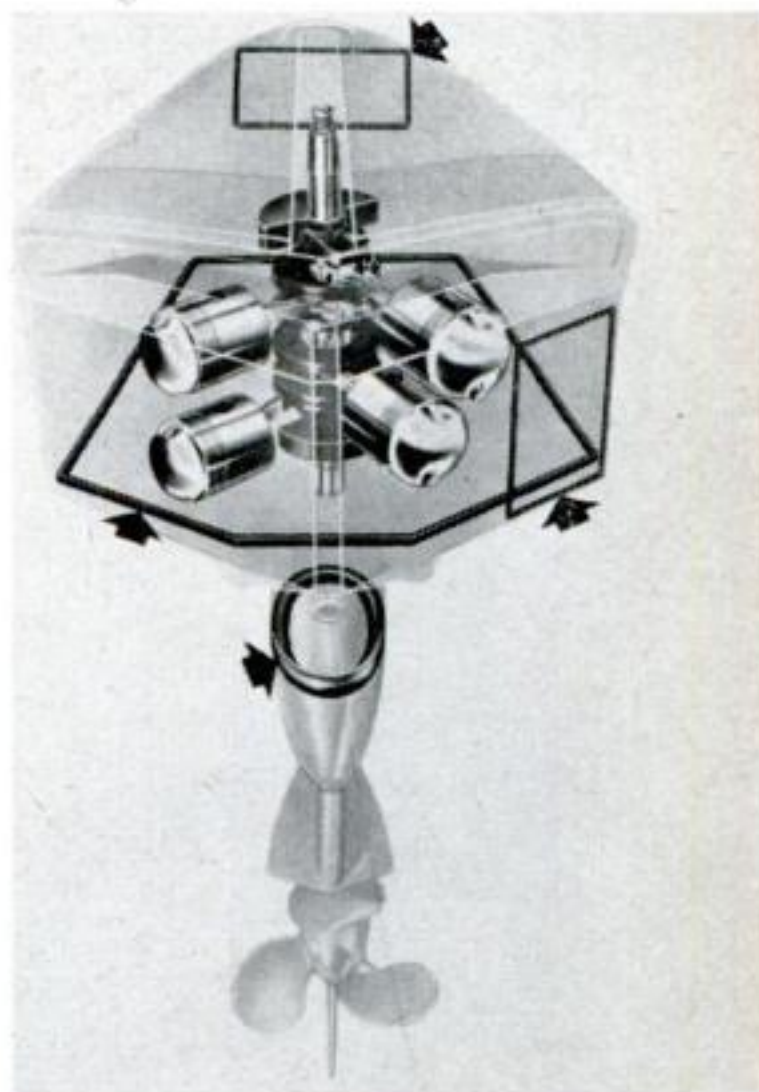
Remote shift and throttle controls are standard equipment. The throttle and gearshift cables are operated by a single lever instead of separate levers. With this one lever, the motor is shifted from forward to neutral or reverse, and the speed is accelerated or retarded, greatly simplifying maneuvering around piers and in other tight spots. As in previous years, Scott-Atwater motors are fitted with Bail-a-Matic, an automatic bailer that operates independently of the cooling system and pumps up to 300 gallons an hour to keep the boat dry.

There's even power steering. Another new Scott-Atwater accessory is a special steering wheel that pivots the motor electrically. Since there's no mechanical connection between wheel and motor, there's

no feedback of vibration or wave shock. As you let go of the wheel, the motor automatically returns to center position after each turn.

A portable plug-in hand control is also available. It lets you steer the motor from anywhere in the boat.

Mercury's new Mark 78 is direct-reversing like last year's Mark 75. Neither has a reverse gear; instead, a single lever with a built-in starter button governs start,



RADICAL V ENGINE, often tried but never put in production until now, is latest entry of both Johnson and Evinrude. It has four cylinders in horizontal V, weighs 205 lb., gives 50 hp. Arrows point to rubber seals (black outlines), said to insulate noise and vibration.

choke, forward, stop, reverse and throttle. When this lever is moved from forward to reverse, the engine actually stops and is restarted with the crankshaft rotating in the opposite direction. On the 70-hp. Mark 78, the choke is automatically actuated when the starter button is pressed; on the 60-hp. Mark 75, it's operated by the ignition switch.

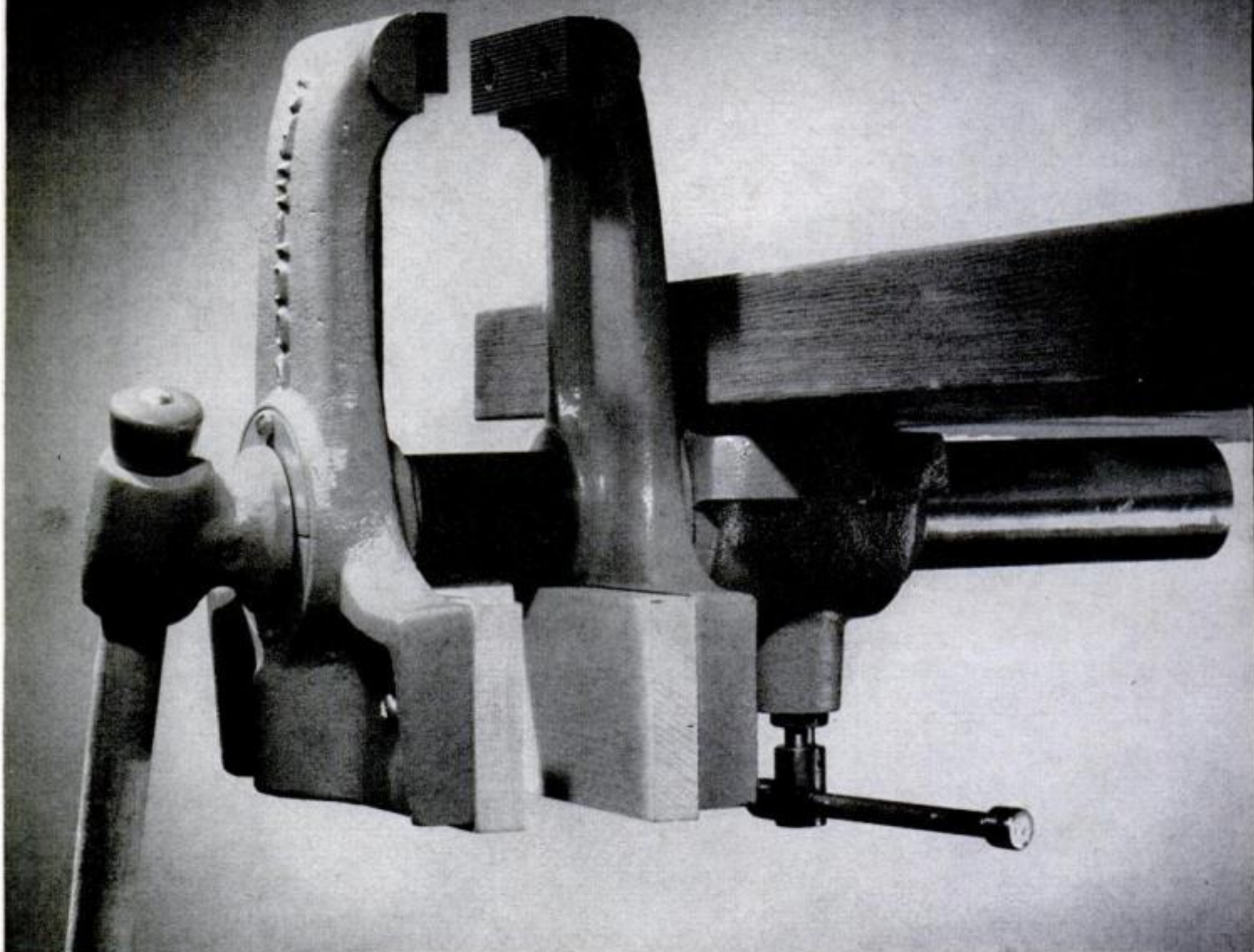
New this year on the larger Mercury motors are hydraulic automotive-type shock absorbers that snub the violent kick-up of the motor and cushion its rebound when boat and motor strike an obstruction in the water.

There's also a new safety tilt switch

[Continued on page 244]

what's new

.....



for the home shop

New two-in-one rotating vise quickly provides metalworking jaws in the up position shown above and woodworking jaws in the down position at left. Woodworking jaws are 7" wide, open to 6½" and—by a unique design—remain partly open even when metal jaws are fully closed, to prevent scoring the wood. Both the metal and hardwood jaw inserts are replaceable in the E. H. Sheldon vise. A socket in the woodworking end also takes a metalworking anvil or clamping pins to exert pressure on large work . . . *A screwdriver with built-in flashlight*, or a flashlight with a built-in screwdriver (whichever way you want to look at it; it serves as either one separately) is available from Silver Bells for \$2.95. It takes regular flashlight batteries, has four interchangeable bits—two standard and two Phillips . . . Stanley, which believes in facing facts, also has a new line

of *screwdrivers with built-in shock absorbers*. As the company puts it diplomatically, "They're for all of us who know that screwdrivers shouldn't be pounded but who still occasionally do it anyway" . . .

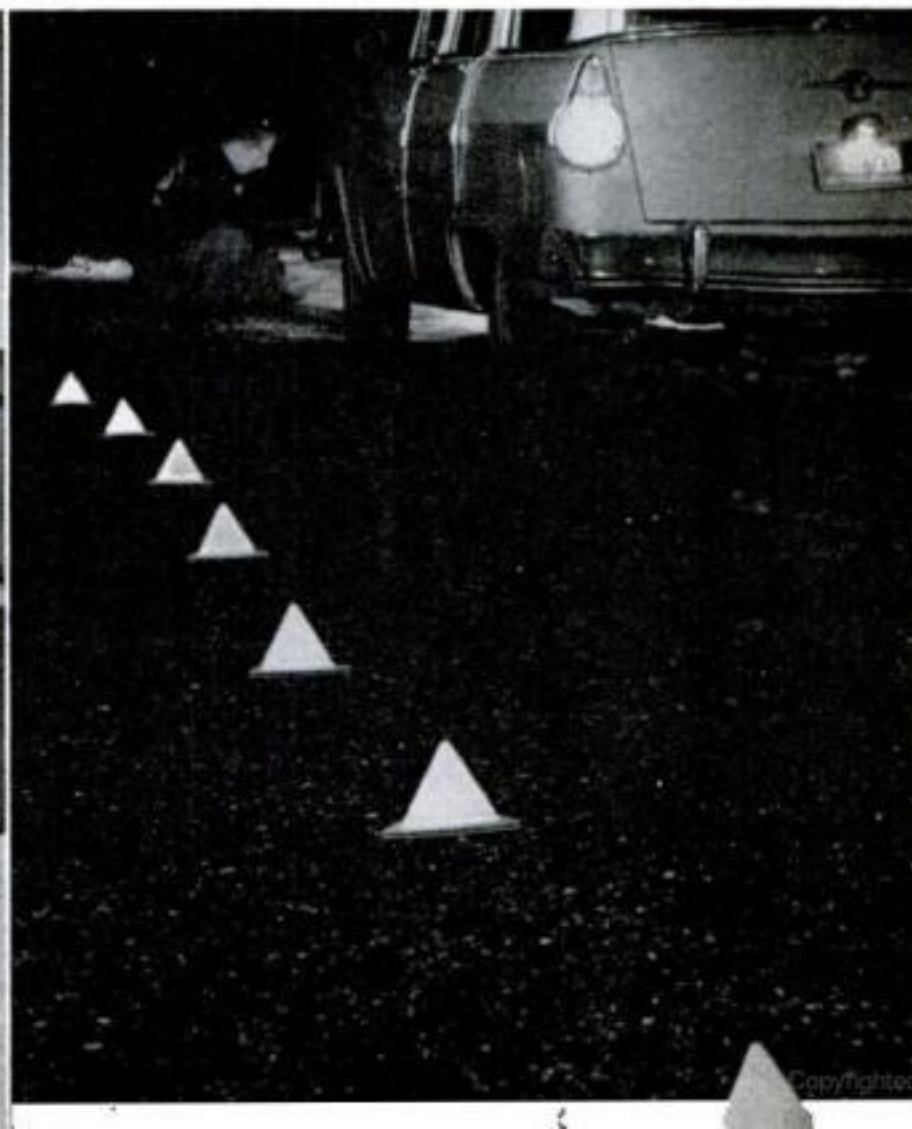
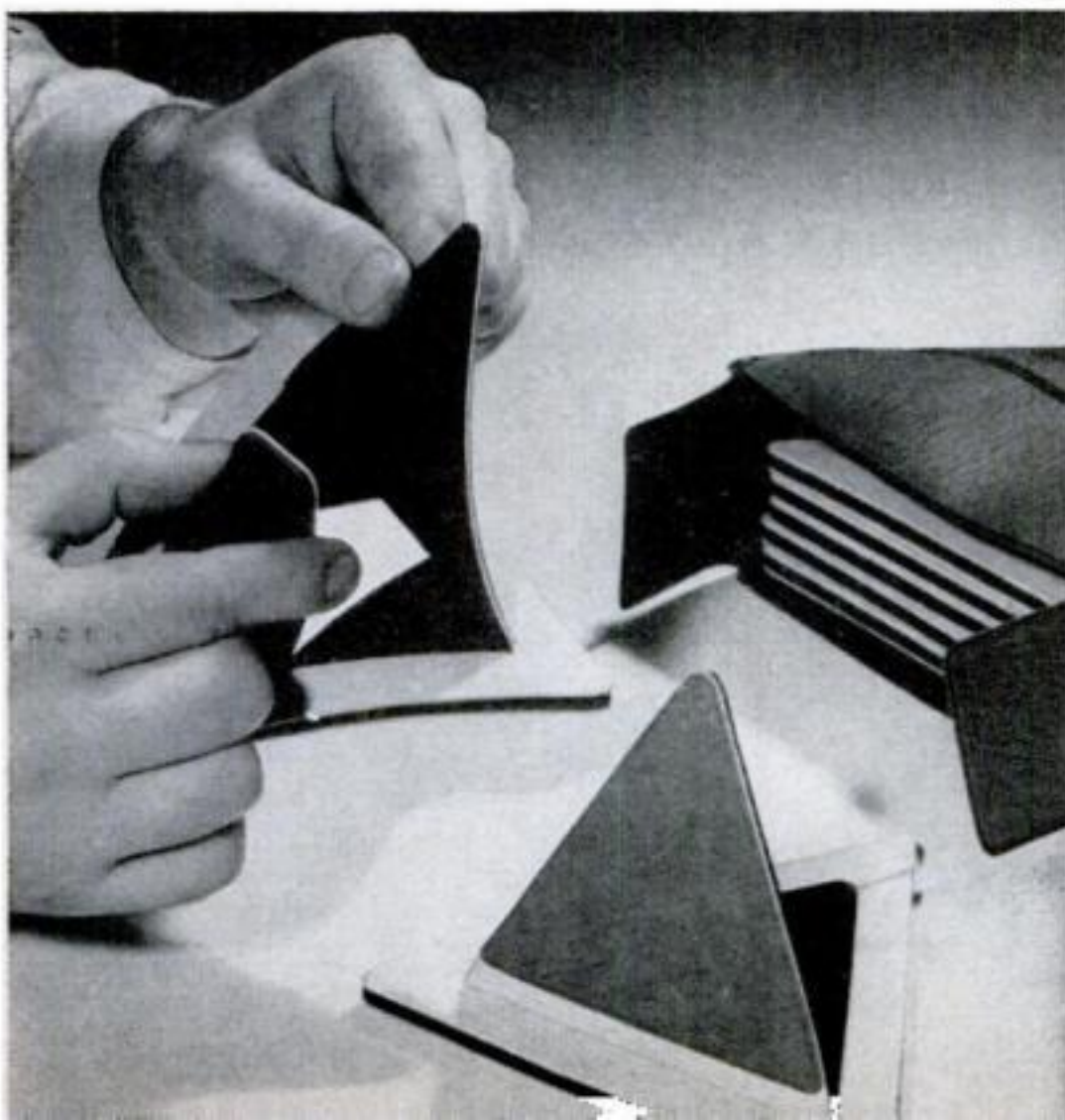
Faster drilling of concrete is now possible with the Ramset tool at right. Available only to professionals until now, it consists of a steel barrel and plunger that quickly drives either a masonry drill or stud fasteners directly into concrete. The new homeowner version sells for \$12.95 . . . If you need *odd-size drill bits*, Hayden will sell you any one you want from .015" to 1" diameter in steps of—believe it or not—.001" . . . *Rethreader taps with hex-shaped heads* fit directly into open-end, box or socket wrenches for quick restoring of worn or damaged threads. Herbrand Tools makes the taps in six sizes from $\frac{1}{4}$ " to $\frac{9}{16}$ " . . . Irwin's *new expanding wood bit* lets you "dial" 35 hole sizes from $\frac{7}{8}$ " to 3" by simply spinning a wheel. It sells for \$3.80.

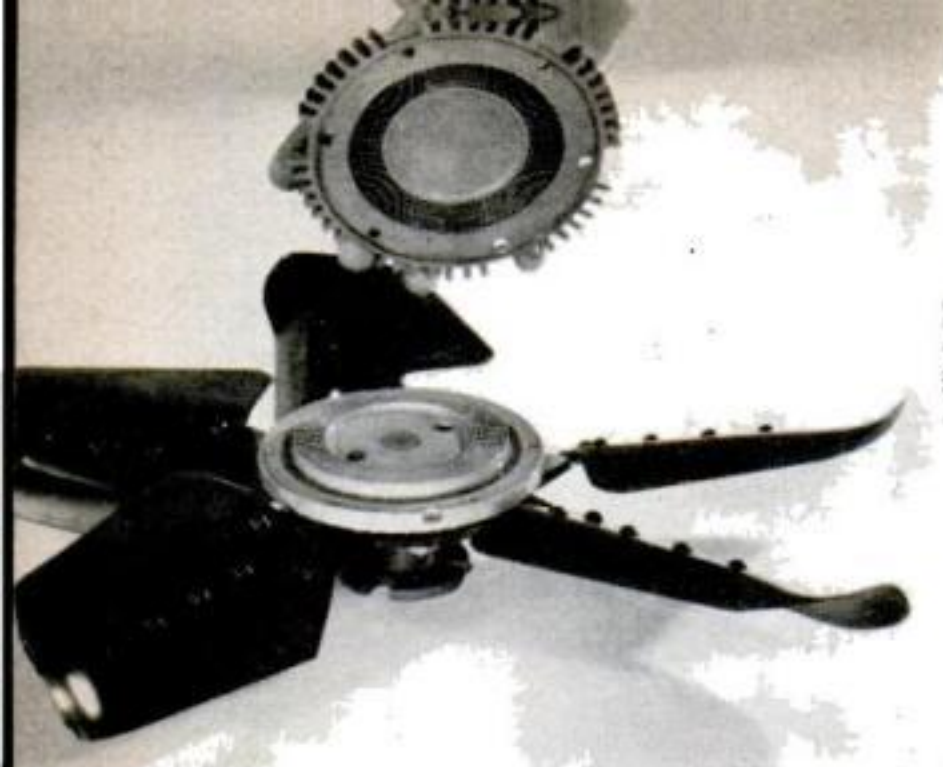


for your car

Evidence of the growing popularity of foreign cars: You can now buy *European socket wrenches* for either the metric or British Whitworth system from, of all people, that good old American institution, Sears, Roebuck. The sets have both $\frac{1}{4}$ " and $\frac{1}{2}$ " ratchet drive, fit such cars as the Volkswagen, Porsche, Austin, MG and Jaguar . . . Also from Europe come *reflective road markers*, shown below, that can be strung several hundred feet behind a car to warn approaching motorists when you have to make roadside repairs. The collapsible rubber triangles are faced with American-made fluorescent Scotchlite tape and are

**More new products
on the next page**





not damaged if they should be accidentally run over. Ewald Kongsbak sells a set of seven for about \$6 . . . A **hydraulically driven fan blade** (at left), gives you cooling at low speeds when you need it most, then cuts out at high speeds. This is said to reduce fan noise and save up to 10 hp. The secret? A fluid coupling in the hub lets the fan slip as engine speed increases. O. W. Dietz sells the fan for about \$35 to fit most V-8s since 1954. Another version, made by the Radiator Specialty Co., uses a centrifugal clutch to disengage the blade at high speeds . . .

Two new aids in spray cans: **pushbutton car wax and whitewall cleaner**, both by S. C. Johnson . . . You can add a **plastic sports-car body** to your car for \$300 to \$500 from Almquist Engineering Co.

what's new for your home



Plastic domes for basement windows (at left) keep rain, snow, leaves and trash out of the wells, yet let in sunlight. The aircraft-like "bubbles" bolt to standard metal well liners and have an air gap above the ground that also provides ventilation. They're sold by Accro Plastics for about \$13 . . . Fancier kitchen cabinets are the aim of new **ceramic door pulls** introduced by Stanley. The circular pulls come in two diameters—1 $\frac{1}{4}$ " and 1 $\frac{5}{8}$ "—and in blue, pink or yellow for 65 to 80 cents apiece.



You can install a **prefab garden pool** by simply digging a hole and dropping it in. The one-piece plastic Perma Pool is 4 $\frac{1}{2}$ ' long, 3' wide and 1' deep in a free-form shape. It sells for \$39.95 . . . A new **folding door** works like a Venetian blind turned on its side. Individual, 8"-wide wood louvers can be fully opened to let in light and air, partly opened to block sun but permit ventilation, or fully closed for complete privacy. The doors come 6'8" high and in widths from 2'4" to 4' for \$45 to \$65. They're made by Consolidated General Products . . . The **curved ironing board** at left represents the first major design change in 90 years, says its maker, Arvin Industries. The arc shape is said to permit more natural, free-swinging arm strokes and a 28-percent larger work area. The board, which also has small wheels, sells for \$24.95.

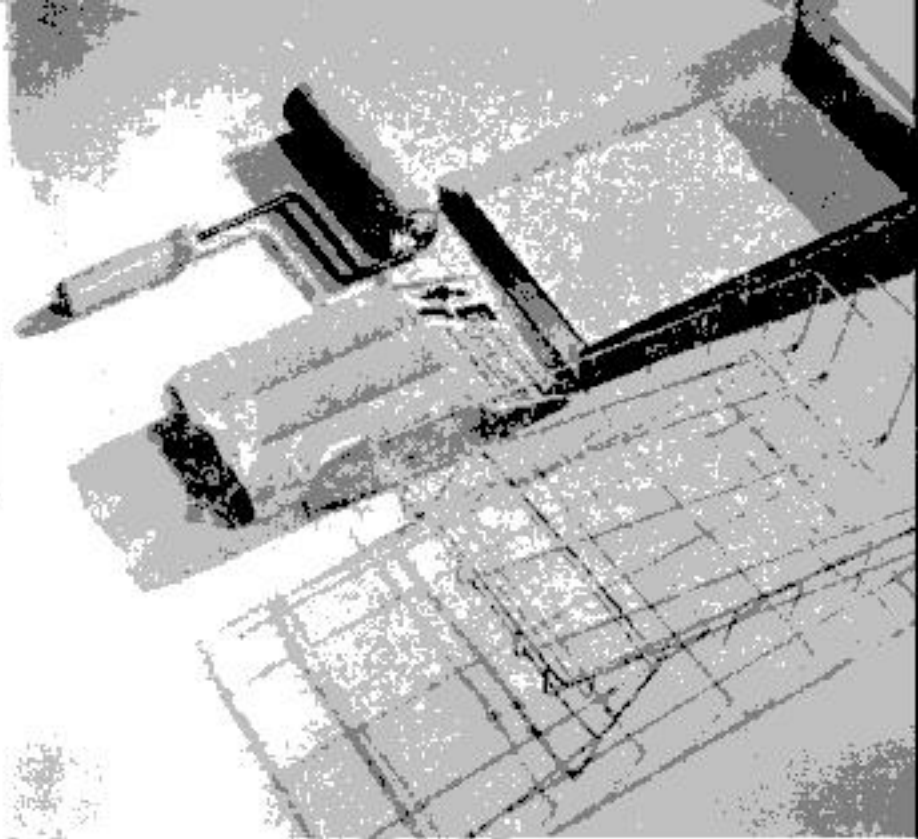
for more information:

Here's where to write if you can't get any item listed above: Accro Plastics, 3272 W. Fullerton Ave., Chicago 47; Almquist Engineering Co., Inc., Milford, Pa.; Arvin Industries, Inc., Columbus, Ind.; Bell & Howell, 7100 McCormick Rd., Chicago

45; Consolidated General Products, 24th and Nicholson Sts., Houston 8, Tex.; O. W. Dietz Engineering Co., 28749 Floral, Roseville, Mich.; Hayden Twist Drill Co., Manila, Ark.; Herbrand Division, Bingham-Herbrand Corp., Fremont, Ohio; Irwin Auger Bit Co., Wilmington, Ohio; S. C. Johnson & Son, Inc., Racine, Wis.; Ewald Kongsbak, 209 Postbox, Lue-

for the home handyman

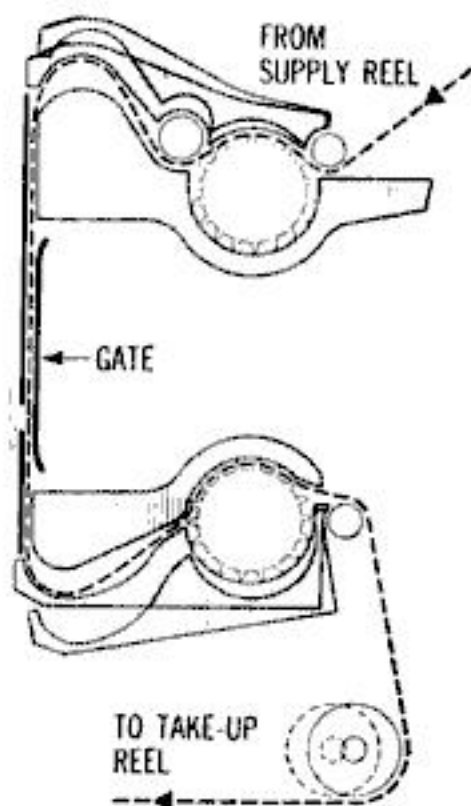
They've finally done it: **disposable paint rollers and trays**. The foam-plastic roller sleeves (at right) fit all standard 7" handles, can even be cleaned for re-use; but don't bother, says the maker, Harry Serwer—you can buy three for 79 cents. The trays are cardboard liners that fit into a wire basket. They're three for 45 cents . . . **You can "paint on" a new roof**, according to claims for a new coating that combines aluminum, asphalt and asbestos fibers. Made in eight colors by James B. Sipe, it's said to waterproof old roofs, seal cracks and reflect heat, lowering inside temperatures as much as 15 degrees . . . **New wood-grained plasterboard** comes with matching-color nails that make it unnecessary to hide heads or joints. U. S. Gypsum makes the panels in simulated cherry, walnut and pine.



just for fun

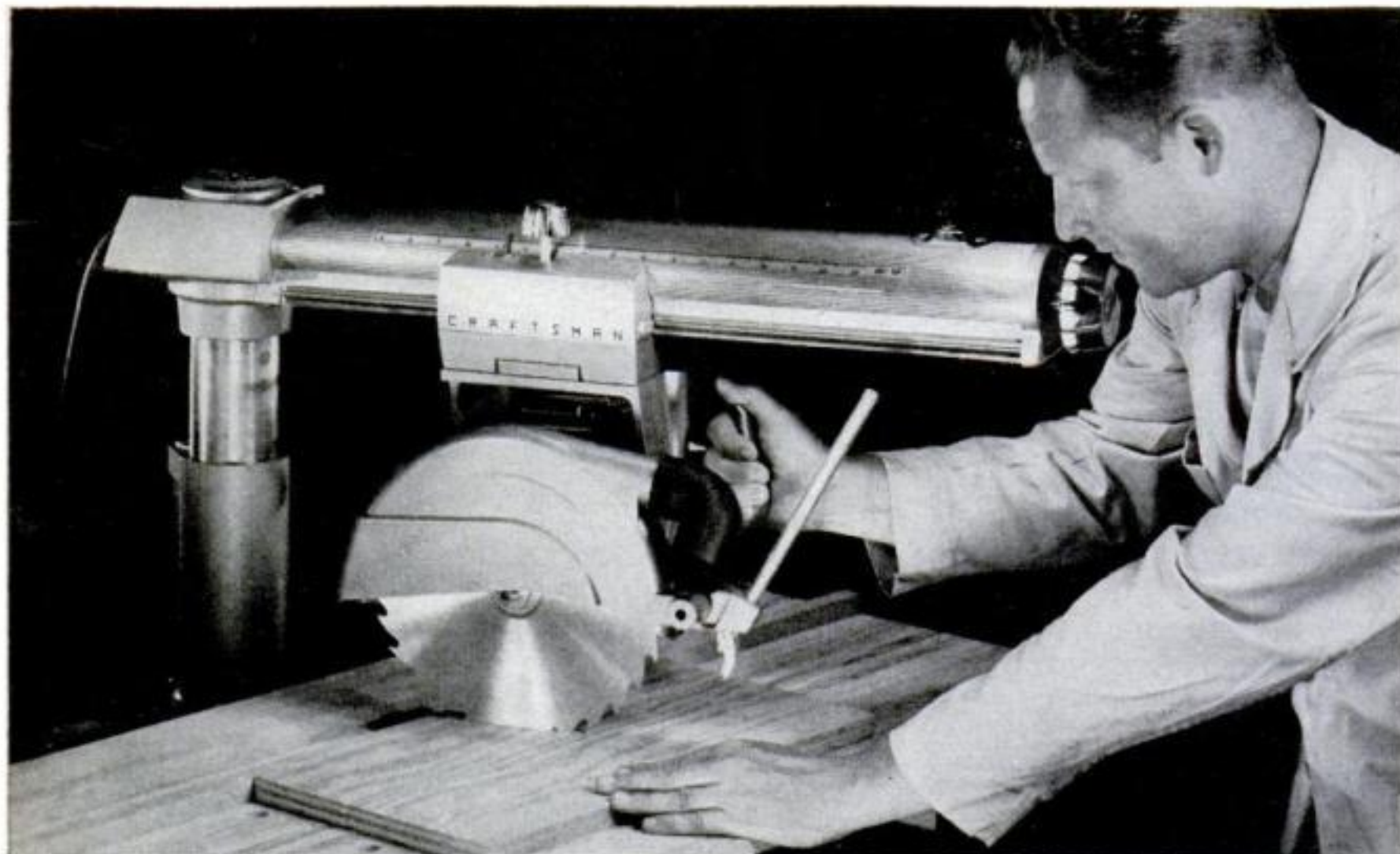
Disposable sleeping bags, originally developed for U. S. Forest Service smoke jumpers, are now available to the public for \$2.95 each. Made by National Fiber, they have a tough, corrugated-paper outside with a cotton liner inside for warmth . . . **The self-threading 8-mm. projector** at right—first of its kind—lets you change reels in seconds. You simply feed the film into a slot and two plastic guides, shown in the drawing, channel it onto the sprockets. If the picture starts jumping because of faulty sprocket holes, a quick tap on the upper guide automatically rethreads the film without stopping the projector. The new Bell & Howell model is priced at \$129.95 with standard f/1.6 lens, \$149.95 with a special lens that lets you vary picture size on the screen without moving the projector . . . **A portable motorized barbecue spit** runs on batteries and requires no bulky firebox. You simply build a fire right on the ground and place the spit over it. L R K of California sells it for \$9.95.

Sheldon Gallager



beck, West Germany; L R K of California, 103 Roosevelt Ave., Redwood City, Cal.; National Fiber & Cushioning Co., Rockingham, N. C.; Perma Pools, P.O. Box 5584, Washington 16, D. C.; Radiator Specialty Co., 1400 W. Independence Blvd., Charlotte 8, N. C.; Ramset Fastening System, 12117 Berea Rd., Cleveland 11; Sears, Roebuck & Co., 925 S. Ho-

man Ave., Chicago 7; Harry Serwer, Inc., 217 North Ave., New Rochelle, N. Y.; E. H. Sheldon Equipment Co., Muskegon, Mich.; Silver Bells Ltd., 1637 Del Monte Blvd., Seaside, Cal.; James B. Sipe & Co., P.O. Box 8010, Pittsburgh 16; The Stanley Works, 111 Elm St., New Britain, Conn.; U.S. Gypsum Co., 300 W. Adams St., Chicago 6.



New Saw Has Many 'Firsts'

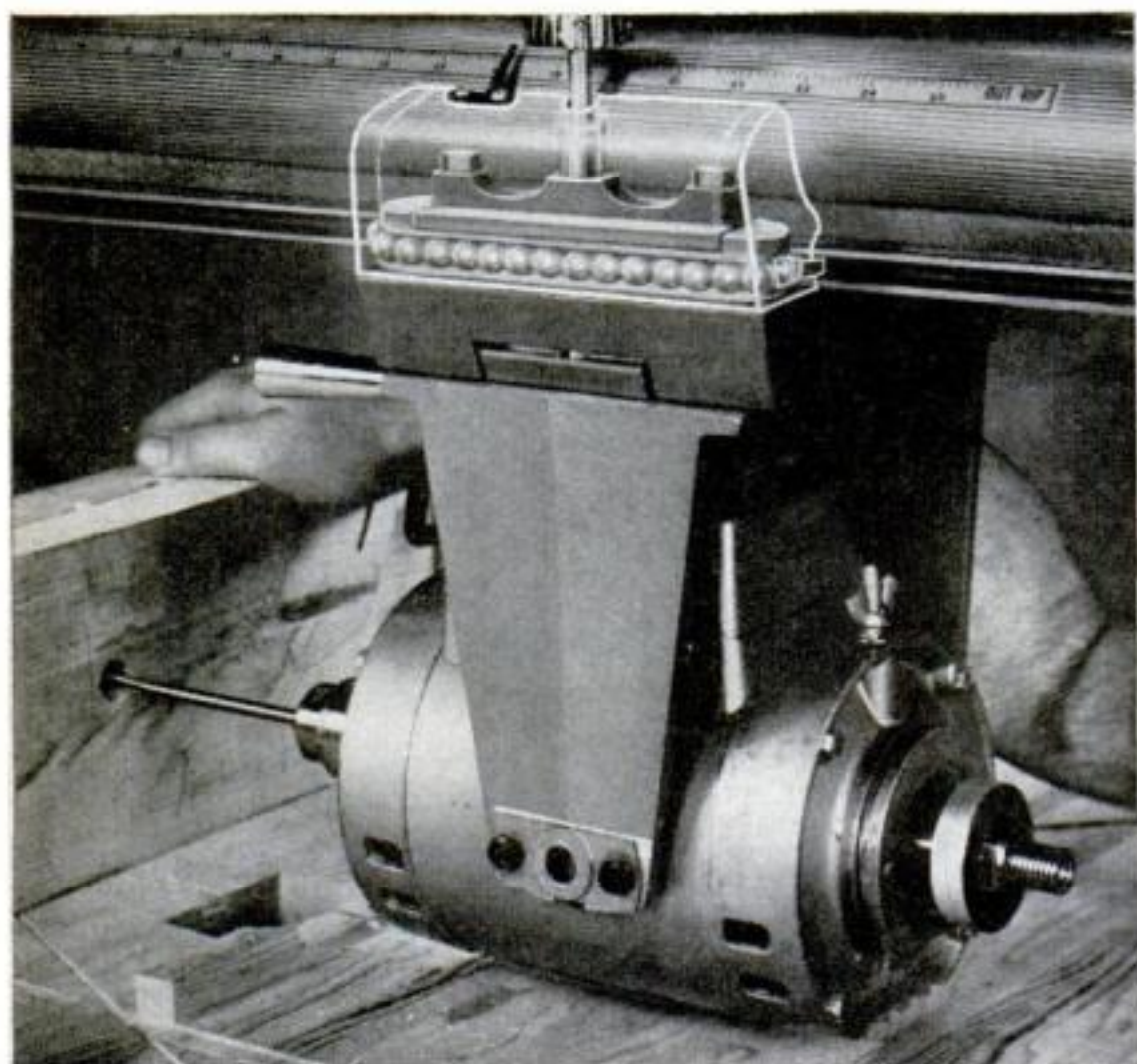
FOR \$229 (\$10 down, 20 months to pay), you can buy one of the hottest power tools to hit the market today—if you don't have to wait in line too long. Out only a few months, the slickly styled radial-arm saw above has already sur-

prised its maker—Sears, Roebuck—by selling so well that orders are hard to fill.

Why? Not even Sears is sure yet, but it figures. Two years in the making, the gleaming gold-and-chrome saw has a remarkable two-hp. motor—largest on a

saw of this price—and a 10" blade with 3" cutting depth.

All controls are in front for easy access, all are color-coded to match the parts they operate—you aren't likely to reach for the wrong knob. Also first on any saw, the new Craftsman has a unique ball-bearing motor mount that rides the arm with a feather touch. "Got the idea," say Sears engineers proudly, "from ball-bearing aircraft turrets."



HUSKY TWO-HP. MOTOR slides easily on 82 ball bearings, 41 on each side of carriage, (drawing at top of photo, left). Two-ended motor shaft is $\frac{5}{8}$ " diameter at near end for saw blade, at far end takes $\frac{1}{2}$ " chuck or arbor for drilling, sanding, shaping and other operations.

Is There a Used Car In Your Future?

Good used cars pack the lots. Many are recent and they come equipped. Here's how to shop

A good used car can sometimes be the best buy on wheels. The reason is depreciation. A buyer who goes for a new Belchfire 880 takes a big licking in the first few years of ownership, when his treasure may lose a third of its value—while traveling only a seventh of its life. So a used-car buyer, by letting someone else take the big depreciation licking, may get more transportation per dollar.

Drawbacks? There are three main ones: 1) The car usually won't be the latest model. 2) Big repair costs may come sooner than with a new car. 3) The innocent or unwary buyer gambles on buying a possible turkey. The following special section, designed to make you a savvy shopper on points 2 and 3, gives information on:

- The new warranty deals that are supposed to serve as lemon-insurance
- Ways to finance a used car
- Insurance coverage you should have
- Tricks a professional appraiser uses
- How to evaluate and compare the condition of the three cars you like best



What about those used-car warranties?

MANY buyers of used cars can pull away from a dealer's lot nowadays without wondering, "How do I know I haven't bought a lemon?"

They'll find the comforting answer in their glove compartments, or in their mailboxes a few days later. It is a legal-looking document that says the buyer won't have to pay a cent for major mechanical defects for one year.

Where do you get it? The simplest way is to shop automobile row for used cars that carry a warranty. Another method is to check the yellow pages of a phone directory for a bonding firm, and query the company about local dealers.

National Bonded Cars, Inc., of Springfield, N. J., has about 5,000 dealers signed up. Car Warranty Corporation, New York City, is another giant in the field, and there are a number of others.

But don't bank on being able to get a warranty on any used car, or from any dealer. The bonding companies dole out their coverage only to the cream of the crop.

How does it work? After a warranty company and a dealer decide to do business, an inspector shows up at the lot. He checks over the eligible cars, and only the ones he passes get warranties. This costs the dealer around \$40 a car, a cost usually passed on to the buyer.

What does it cover? In general, the warranty company pays for one year for most major mechanical repairs. Car Warranty Corp., for instance, covers the parts in the engine, transmission, rear axle, clutch, steering and front-axle assembly, brakes, universal joints and water pump. Any one of these will be repaired or replaced, and the warranty company foots the bill, providing it's a job covered in the fine print.

To protect itself, a warranty company usually puts a few iffy sentences into its warranty. Car Warranty Corp. says that parts failure must "... result from defects in material or workmanship." Another hedge is the use you'll give your car. You can forget about warranty protection if you register the car for commercial use, say for a business fleet operation.

Says the president of one: "We don't squawk about backing a typical hard-driving traveling salesman. But we might back down about covering a heavy-hardware salesman who fills his back seat with a ton of samples."

Payment of repair bills is said to be fast, no longer than a day or two. The bonding companies suggest you take repair jobs to your original dealer. On a trip or vacation away from home, you can turn repair troubles over to the company's closest branch office.

Caution: There is one point to remember if you want to get this protection. A used-car warranty is like any other guarantee: Its legal prose and engraved paper can't protect you from a shady dealer or a weak bonding company. So ask your dealer for the facts about his warranty company.



Where will you get the money?

ONCE you've picked out the best used car on the lot, you'll need a source of cash. You'll want a finance plan that costs you as little as possible, with payments within your monthly budget and a reasonable interest rate.

A shrewd used-car buyer should have a couple of financial facts up his sleeve. The first: You don't *have* to finance the car through your dealer, or through any plan you don't like. Comparing the time-payment plans of your dealer, a bank and a finance company is only common sense.

On trade-in deals, the important dollars-and-cents figure to you is the "cash difference"—the net cost after you've deducted the trade-in allowance from the dealer's price tag.

Don't try to hold the dealer up for an exaggerated trade-in. He'll have to hike his total price to allow for it.

Your down payment should be roughly a third the price tag on your used car. (That's true, too, when you walk in with a cash down payment.) "One-third down" is a must with most banks and conservative finance companies. It gives you an equity in the car that you can refinance if, later on, you want to stretch out your payment period.

Borrowing money to finance that "cash difference," you'll find, can vary in interest rates. "Rates are purely relative," says one banker. Here's what he means:

The borrowing cost is often higher for

an older car (10 to 14 percent) than for a shiny new showroom model (five percent to 12 percent). What's more, a salaried man can usually get a lower interest rate than an hourly paid worker.

Four different methods are used for financing a used car. In the order most frequently used, they are:

Sales contract with a dealer. Here, everything is handled by the dealer. It cuts down the legwork and red tape for you. The most common drawback is higher cost: from 10 percent up.

Mortgage loan. You get this at a bank or a finance company. The loan is issued as a mortgage on your car, or some other property. The rate: 10 percent for a used car up to two years old, 13 percent for one older than that.

Collateral bank loan. You put up collateral such as stocks, bonds, real estate or even life-insurance policies. The security is left with the bank, though you keep any income from it. Payment is in a lump sum at the end of the loan period. Interest: five to six percent.

Signature loan. Signing on the dotted line gets you the cash, after the banker has decided that you have a steady enough job, a good credit rating and an honest face. Interest: 7½ to 12 percent.

Before you clinch the deal, take time to double-check the price your dealer asks, his trade-in allowance, and possibly his financing plan.

Don't let a fast-talking salesman con you into risky financing. Beware of two well-worked gimmicks: "No-down-payment" deals, and "balloon notes."

"No down payment" means you borrow the works. You sign for a chattel mortgage, and pay up to 50 percent a year in interest. Default and you risk losing not only the car but your furniture to boot.

"Balloon note" financing works like this: The salesman lets you set the amount you want to pay each month. (His concern for your budget will overwhelm you.) Your installments eat away at only part of the debt. The final installment is the balance: one big payment that leaves you feeling faint. You pay it in a lump sum, or else.



What insurance should you have?

GO SHOPPING for your insurance just as you would for a loan. A wise purchase can mean hefty savings.

A dealer or whoever backs your loan will demand some insurance on the car, as "loan protection." Usually he demands collision, fire, theft and comprehensive (flood, windstorm and the like) coverage. But it's up to you to get the other necessary insurance: property damage and liability.

Here's where it helps to shop. A finance plan and its "loan protection" are often combined as one deal by the dealer, bank or finance company. But you can combine the "loan protection" with the other coverage you need, and buy the package cheaper through one insurance company or a broker.

Paying your premiums on a yearly

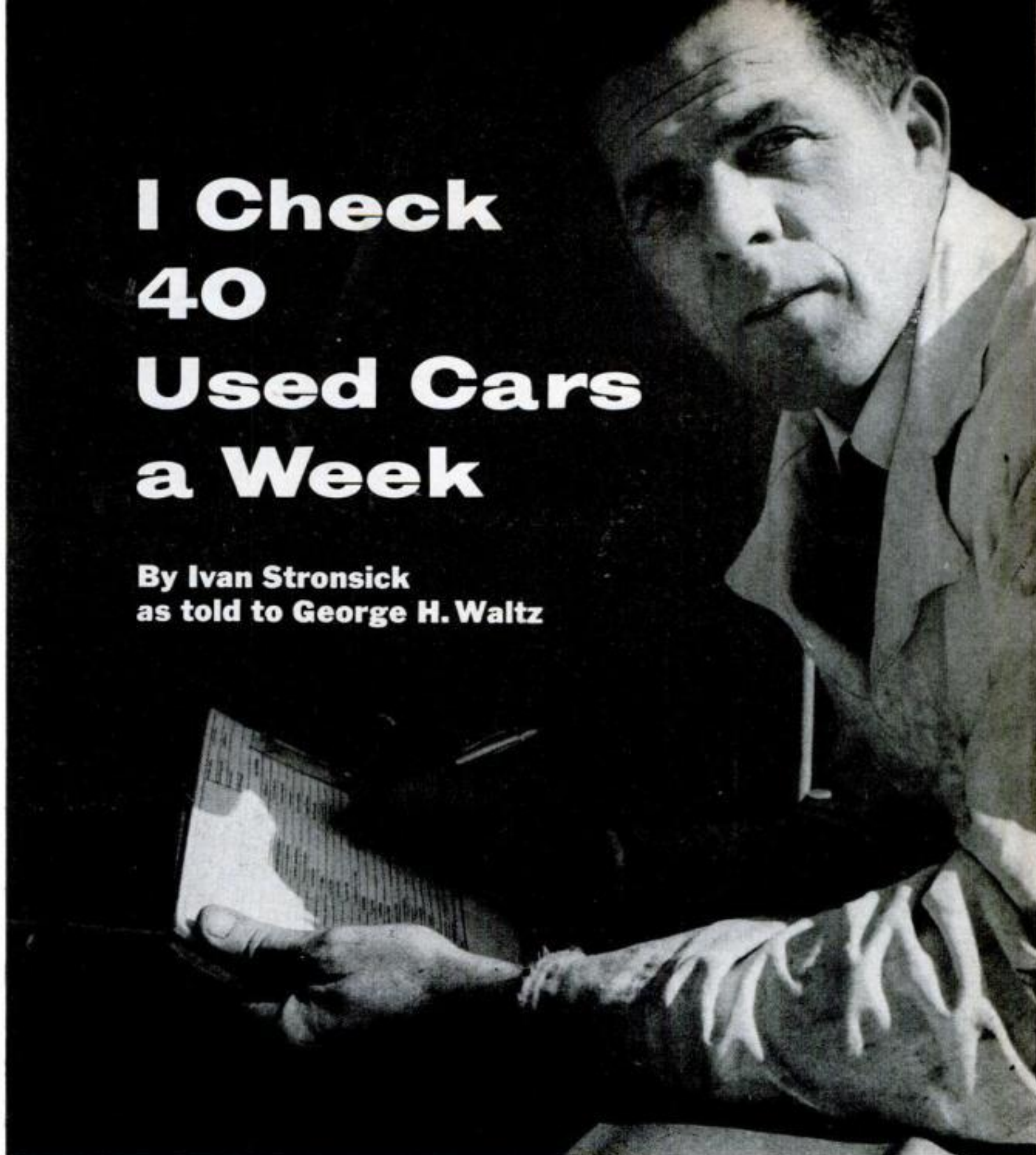
basis is usually cheapest for you. Insurance that's included with a three-year loan is a trifle cheaper than three times a one-year premium. But paying once each year you aren't stuck for the interest charges on the insurance, which is spread over the loan period. And from one year to the next, your fire, theft and comprehensive rate will fall as your car's value depreciates.

Make sure you are put into the right age group, particularly if the drivers in your family are over 25. Otherwise, your premiums can double.

If money is tight take a big deductible for your collision coverage. Premiums go down as you agree to pay more in fix-up costs. You can save almost 25 percent by taking a \$100-deductible policy instead of a \$50-deductible.

I Check 40 Used Cars a Week

**By Ivan Stronsick
as told to George H. Waltz**



Ivan Stronsick, above, works as inspector for a company that guarantees used cars against major defects. During the war he served as a transport maintenance man in the Marine Corps, later ran his own auto-repair shop in Philadelphia

CHECKING used cars is my business. In an average week I go over as many as 40, looking for trouble. My job is to take the gamble out of used-car buying. When I finally do okay a used car, you can bet, fairly safely, that it's basically sound.

I'm a trained inspector for The Car Warranty Corporation, one of several national outfits that guarantee used cars offered for sale by reputable dealers. Once a car displays my company's seal, the buyer can enjoy a year's driving with-

out fear of being nicked for a major repair job.

I break down my inspection of every used car into three main parts. You might call them a "preliminary check," the "road test," and the "final inspection." Each is important and each can turn up troubles.

I start my preliminary check with a slow walk around the car. Generally, you can tell a good deal about a car from its outward appearance. If a car looks messy outside—dents, scrapes, rust holes—the



"Most car noises can be checked best with all car windows closed," says Stronsick. "But I also drive through an underpass—the longer the better—with the driver's window open. That way I hear noises reflected from under the car."

chances are that its innards, too, have been badly neglected. There are exceptions, but not often. If a car looks beat up I double-check everything.

On a comparatively clean car, I look for extensive refinishing that could be the result of major repairs after a smash-up. Looking along the side of a car you can spot surface irregularities that generally mean body work. From this angle, you can also spot painted-over lettering or designs indicating the car was once a taxicab or a company car and is sporting a face lift.

After the walk-around, I really go to work, starting at the front. First, up goes the hood, and I inspect the radiator, not only for leaks, but for water level (it should be up to the gooseneck) and for any traces of oil in the water. I inspect fan, fan belt, hoses, water pump. Then I give the entire engine a visual check,

looking particularly for oil leaks at the valve covers, fuel pump, timing-gear cover, and the crankshaft front oil seal. I look for traces of water and rust around the cylinder-head gasket (or gaskets) that might be a tip-off to cracks. If the car has power steering, I look for oil leaks or damage at the hoses and the oil reservoir. If the master brake cylinder is under the hood, I check it for fluid leaks.

When I find anything that looks like an oil or fluid leak, I carefully wipe the area clean so I can recheck that point after my road test.

While I'm under the hood, I also check the crankcase oil level with the dip stick (if the dip stick is bent I borrow a good one). At the same time I look for any traces of water in the oil. If the car has an automatic transmission, I check its fluid level.

Getting into the driver's seat, I try



"I check front-wheel bearings by jacking up the front end, spinning the wheels one at a time and holding my hand on the front bumper or on the frame," says the inspector. "That way I can feel any bearing roughness."

the steering gear for too much play. I turn the wheel from extreme left to extreme right to detect any binding that might mean a badly worn worm or sector. Needless to say, I've already checked the front tires for any signs of uneven wear that might mean steering troubles.

My next stop is under the car. I like to get it up on a grease rack, but if I can't I just slide under. Here again, I look particularly for telltale leaks of oil, grease or fluid under the engine, transmission, clutch, universals, brake lines, the backing plates on the wheels, and rear-axle housing. As before, if I find any leaks, or what look like leaks, I wipe them clean so I can recheck them after the road test.

Out from under again, I start the motor and listen for any unusual noises or knocks. I watch the oil-pressure gauge or the oil-pressure indicator light. Pres-

sure should build up after the first few revolutions of starting. If it doesn't, it may indicate loose crankshaft bearings or a bad oil pump.

If the car is a "stick" model, the clutch comes next. As I push the clutch pedal down with the motor running I listen for any noise that might mean a worn throw-out bearing. Then I put the car in low and give it the gas slowly. If it chatters, I look for a worn clutch or defective engine mounts. I check clutch slippage by putting the car in high, setting the brakes, and giving it the gas. If she stalls, okay.

The hurdle now is the road test. For this, I try to pick a nice smooth, black-top highway that's not too busy and that has a hill or two as well as long level stretches. If you're wondering why I like a blacktop, it's because I use my ears a lot during a road test, and a concrete road is too noisy—sets up too many tire

noises. For the same reason, I won't road-test an automobile fitted with snow treads.

I generally drive the car for at least eight miles to give it a chance to warm up properly before I start listening and checking. Of course, I can't help getting some feeling about the steering, the brakes and the engine.

On a car with a regular transmission, my first check is to try it in all gear ranges, including reverse. Knocks in any range mean broken or chipped gear teeth and a whine or a howl means badly worn teeth. While I'm at it, I double-check the clutch again to make sure it's working properly.

On a car with an automatic transmission, I check it in all speed ranges, making sure it goes through all the downshifts as well as upshifts. If it clunks loudly between shifts, that probably means trouble. I pay particular attention to how the car reacts from a standing start in the drive range. It shouldn't grab or chatter. Finally, with the brakes set and the transmission again in the drive range, I give it the gas to test for too much slippage.

If a car has overdrive, I try the cut-in and listen for any growl that might signal trouble. I also check the operation of the kickdown from overdrive and the drop-out to free-wheeling.

While making all of these tests, I've always got my ears cocked for any clunking sounds that might mean a worn universal or any kind of bad backlash in the drive system. If I suspect anything, I let up on the gas every now and then and listen for drive-shaft noises.

All the while, too, I'm listening for motor noises—knocks, pings and skips—and thumps and bumps that might mean suspension troubles. I'm also instinctively checking the steering for wandering, and the brakes for noises and pulling to the right or left.

I've found that most car noises can be checked best with all of the car windows closed. But I also try to drive through an underpass—the longer the better—with the driver's window open. That way I can hear noises reflected up from underneath the car.

If the car has power steering, I pull over to the side of the road, stop, and turn the wheels, first with the engine idling and then with the engine off. Besides making sure there's quite a difference in effort required, I also listen carefully for a slight buzzing sound that means that the pressure-relief valves are working properly when the engine is running.

Back at the lot, I put the car through its final inspection. My first job is to check out all of the possible leak points that I wiped clean during my first go-round. Any new signs of grease, oil or fluid bear out my first doubts and I check further. For instance, if the back plate on a wheel shows new grease streaks, I pull the wheel to inspect the seal. In the same way, if my road test showed that the brakes had a tendency to pull, I pull the front wheels to check for possible hydraulic leaks. At the same time, I check the linings and drums.

If I have the slightest reason to suspect that the car is an oil burner—smoking exhaust, signs of blow-by from the oil breather pipe, lack of power—I run a complete compression check. The compression readings on all cylinders must be within a 15-pound range of each other.

Regardless of what the road test showed, I check the front-wheel bearings by jacking up the front end of the car, spinning the wheels one at a time and holding my hand either on the front bumper or on the frame. This enables me to feel any bearing roughness.

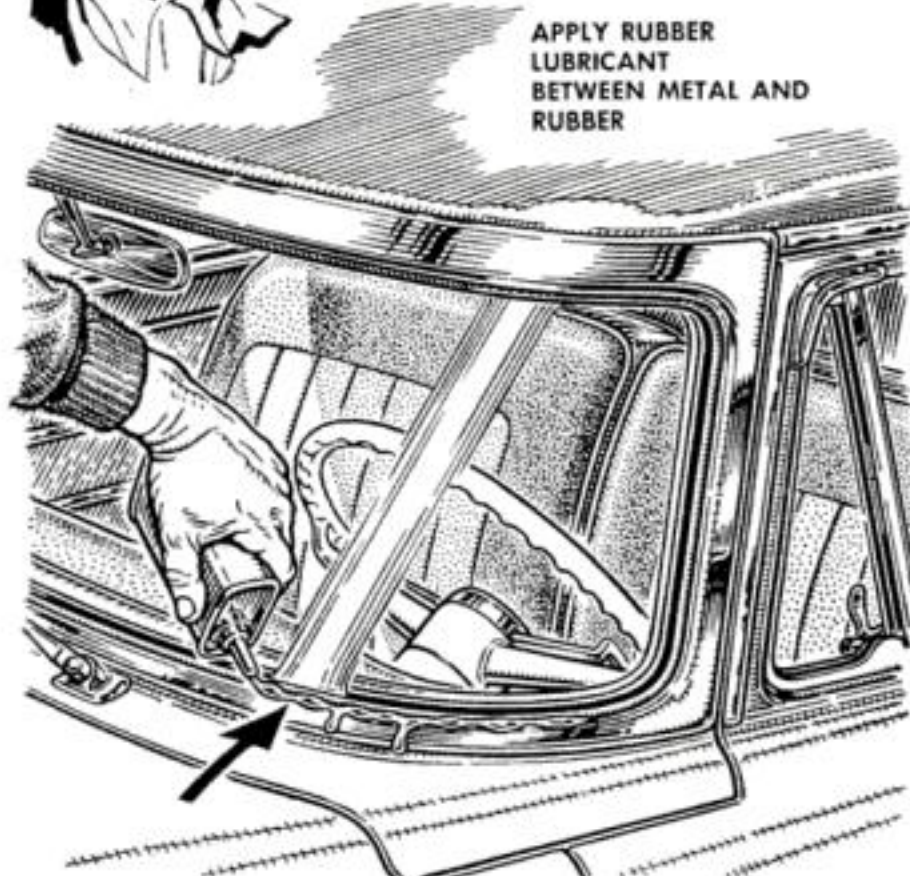
Front-end suspension I check by jacking up the front end, one side at a time, and inspecting the upper and lower control arms for wear. I test kingpin wear by grasping each wheel at the top and bottom and applying a tilting motion to detect any play.

When you have looked over as many cars as I have, you develop a sort of sixth sense for locating trouble. However, sixth sense or no, I think two of the surest clues to possible trouble in the modern car, with its power-operated gadgets, are unusual noises and leaks. Both mean troubles that can cost considerable to fix. One thing sure—I won't put my okay on a used car that has either. **END**

NEXT MONTH: Like to do your own car maintenance on weekends?
June PS will tell you about four easy Saturday-morning jobs.

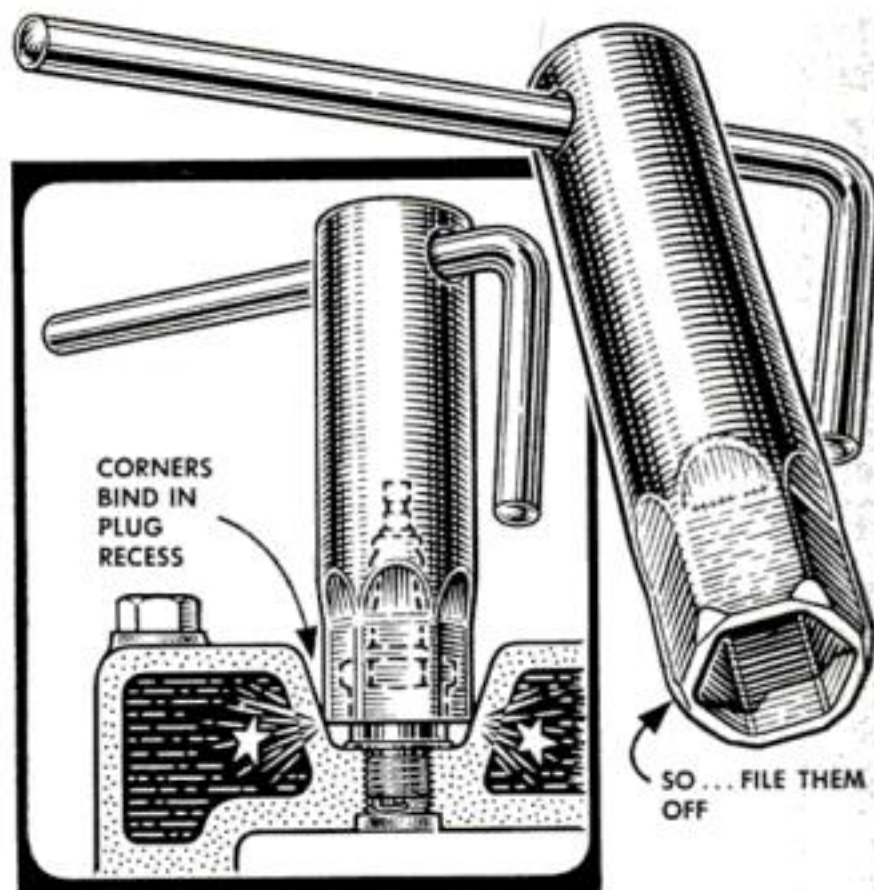


Hints from the Model Garage



APPLY RUBBER
LUBRICANT
BETWEEN METAL AND
RUBBER

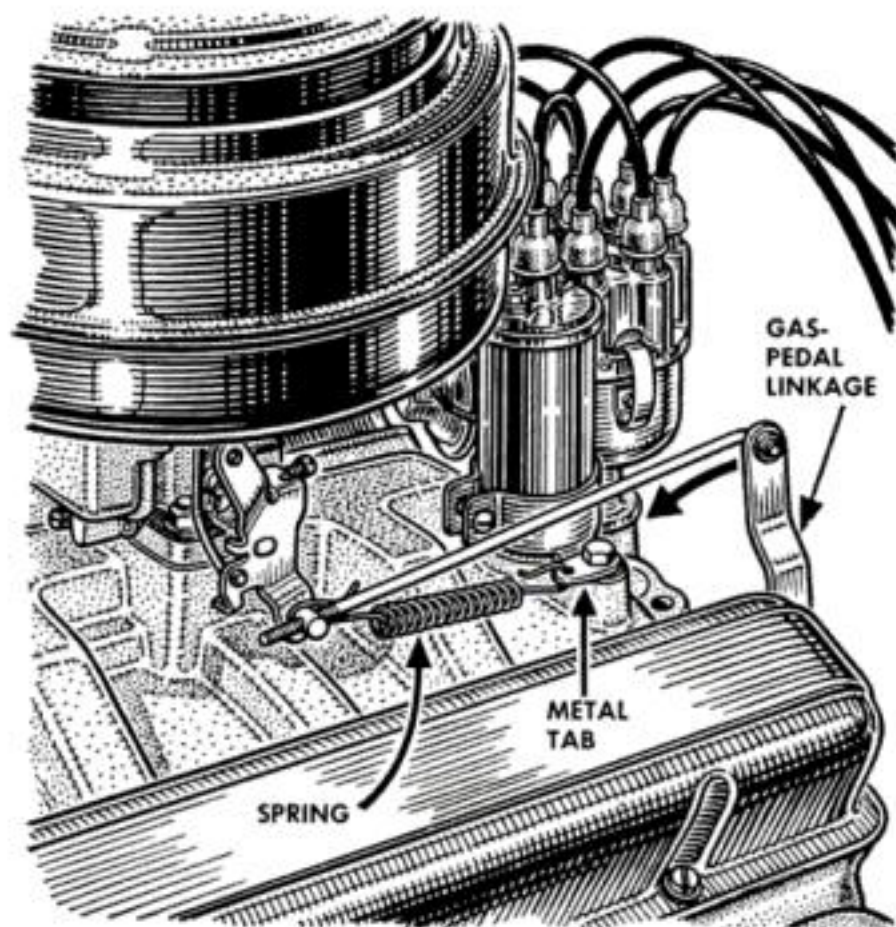
To stop an annoying squeak caused by vibration of the windshield in its opening, trickle silicone rubber lubricant between the metal molding and the rubber channel. If this doesn't silence it, force sealing compound between rubber and glass.



CORNERS
BIND IN
PLUG
RECESS

SO... FILE THEM
OFF

A spark-plug wrench will work easier if you file off the sharp outside corners. This small effort will prevent the six-sided wrench from binding or digging into the plug-recess sides as you exert pressure to loosen or tighten the plug.



GAS-
PEDAL
LINKAGE

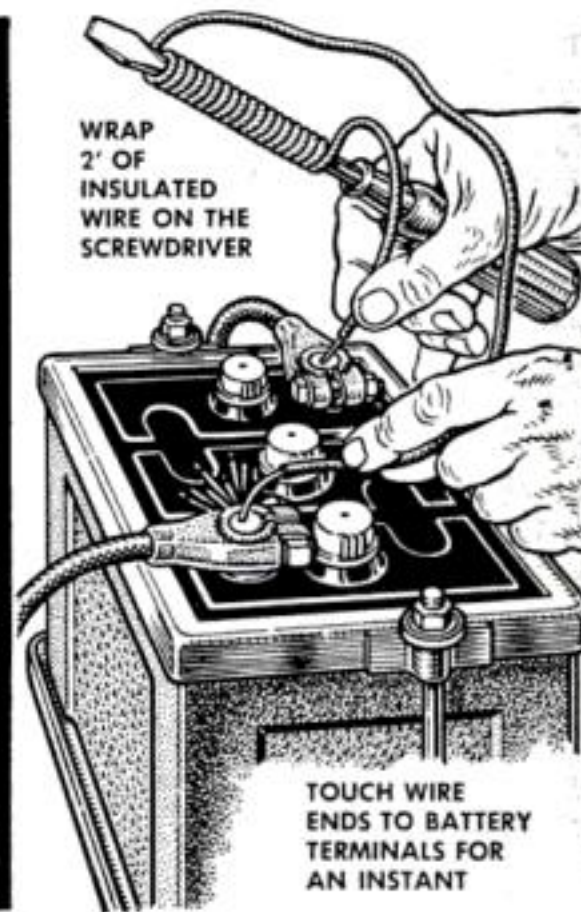
METAL
TAB

SPRING

Erratic idling—fast one time, slow the next—can often be corrected by adding a 10-cent spring to the throttle linkage. Stretch the spring far enough to insure positive throttle return, and secure it to a metal tab held by a head bolt.



FISHING
FOR
DROPPED
PARTS

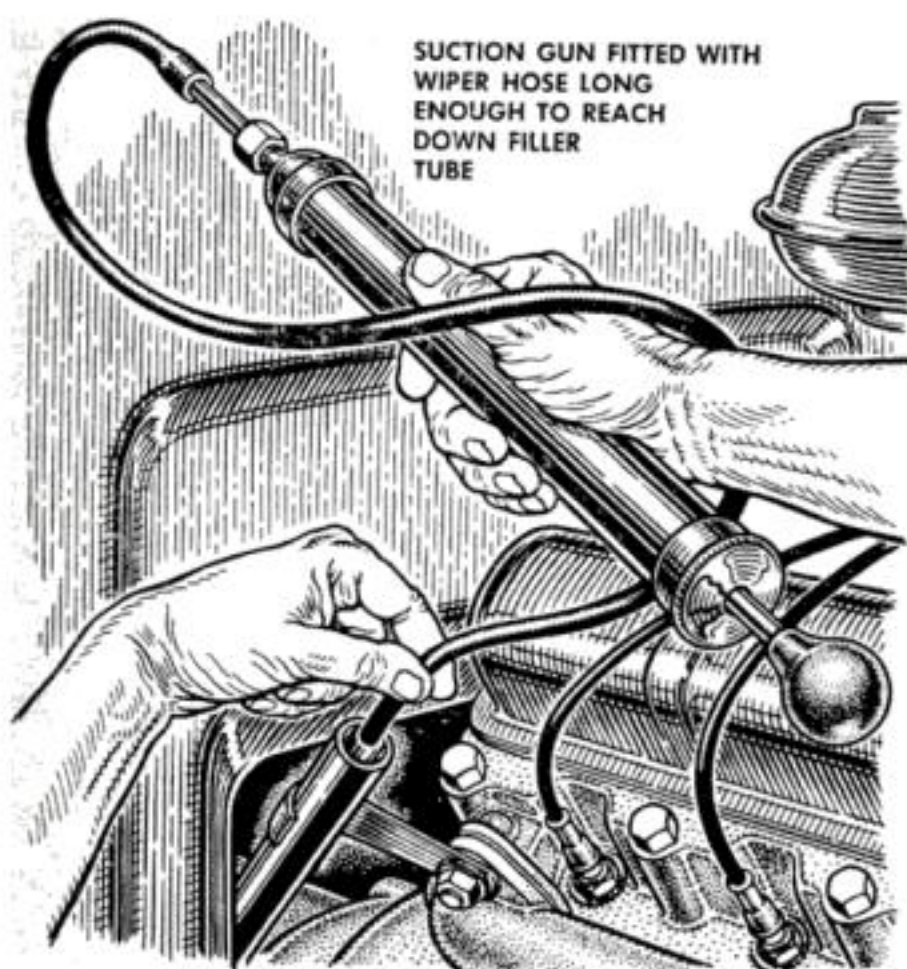


WRAP
2' OF
INSULATED
WIRE ON THE
SCREWDRIVER

TOUCH WIRE
ENDS TO BATTERY
TERMINALS FOR
AN INSTANT

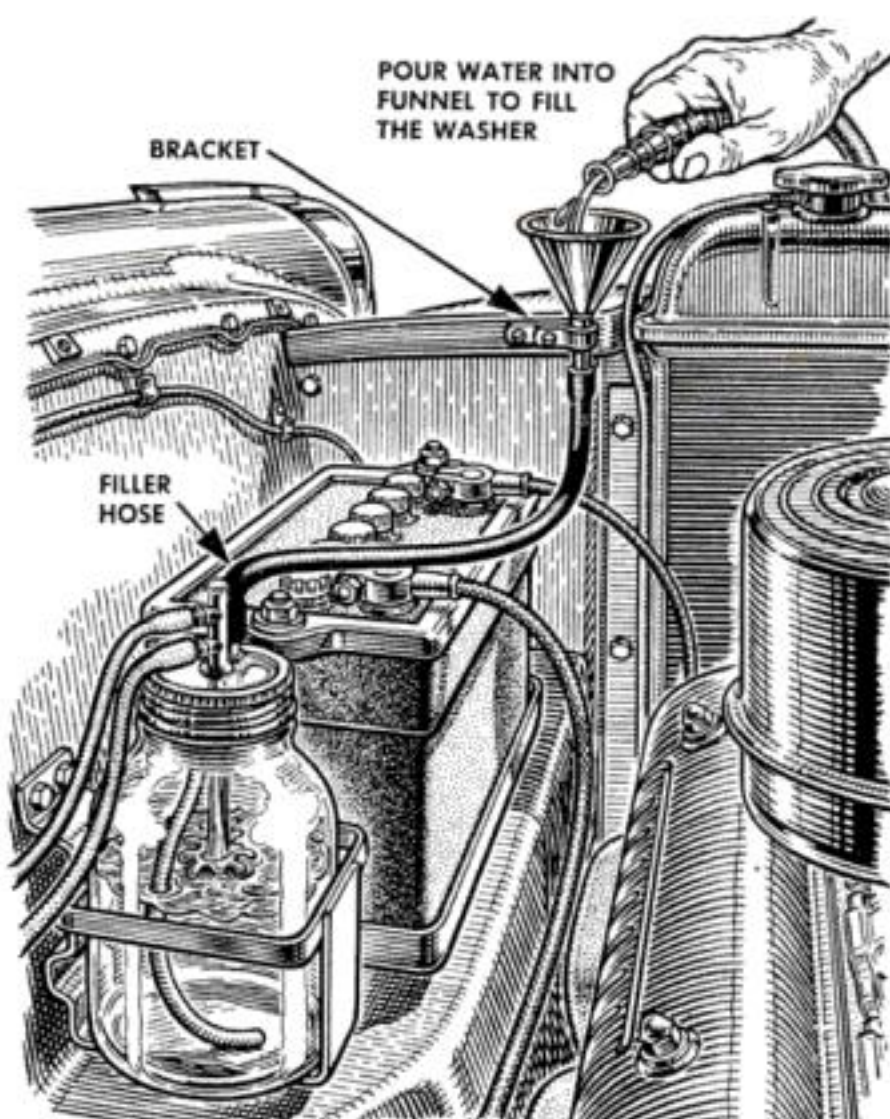
If a nut or bolt drops into an out-of-reach place, retrieve it with a magnetized screwdriver. Wrap the tool with insulated wire and briefly touch the ends to the battery. Then tie the wire to the handle and lower it to pick up the part.

More Hints from the Model Garage

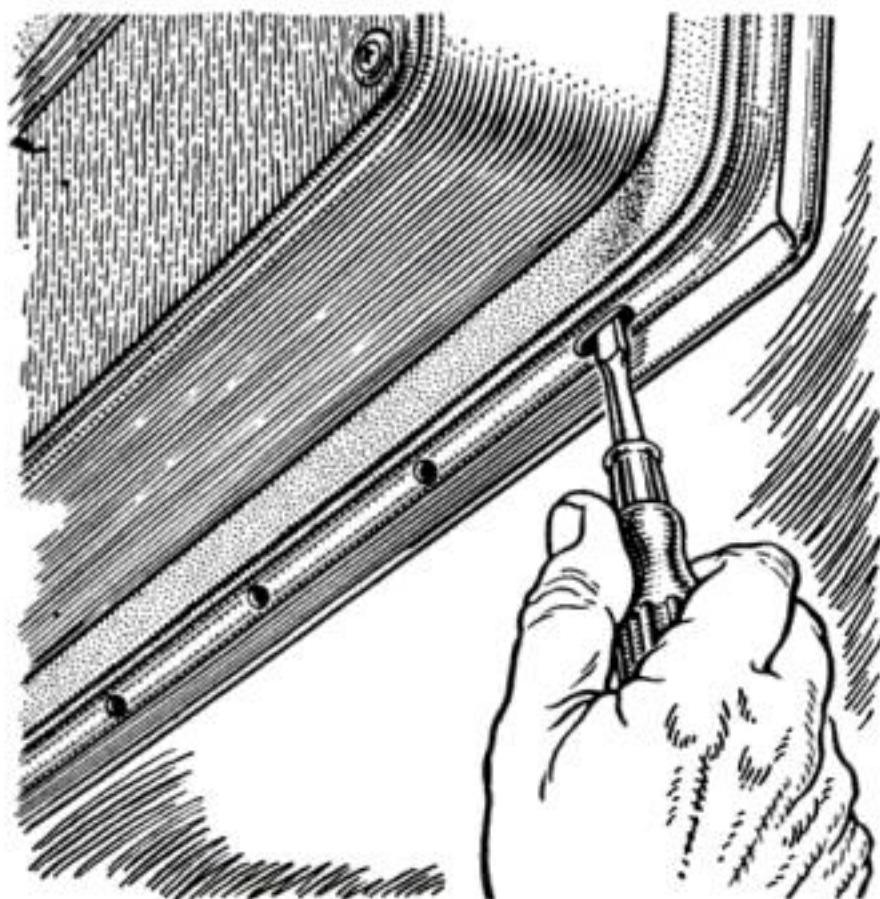


SUCTION GUN FITTED WITH WIPER HOSE LONG ENOUGH TO REACH DOWN FILLER TUBE

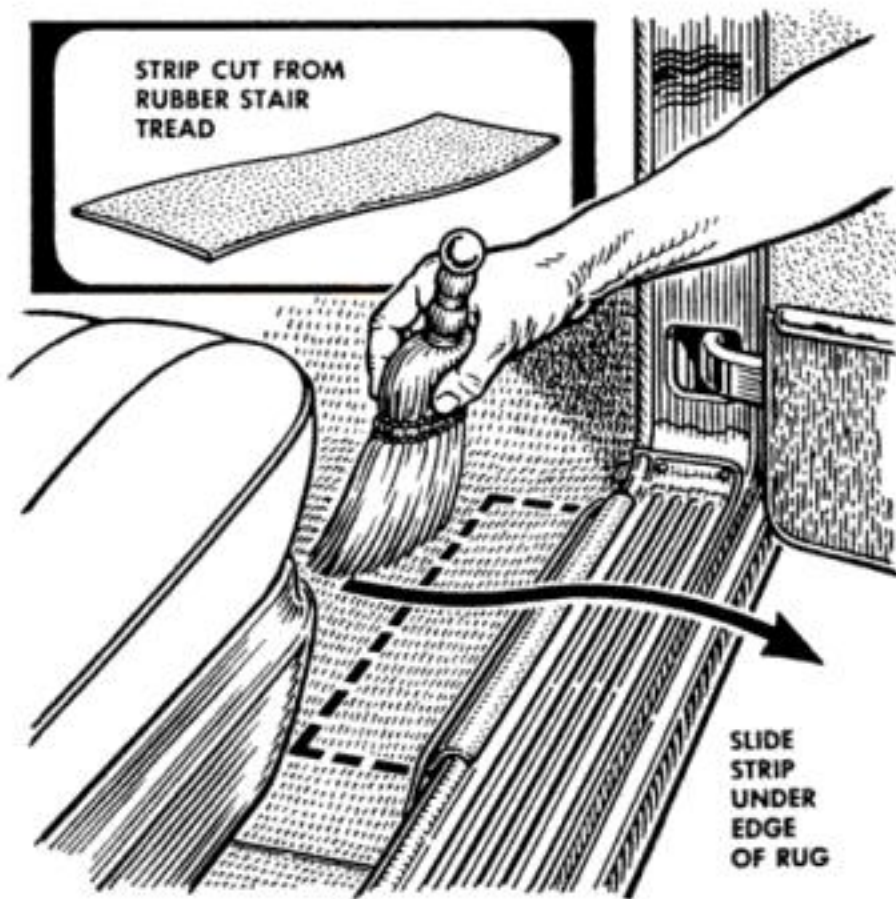
Too much fluid in an automatic transmission can be as unwise as too little. Use a suction gun fitted with a length of wiper hose to draw excess fluid up through the filler tube. Keep the gun clean and don't use it for any other purpose.



You can top off your car's windshield-washer jar every time you check the radiator, with this setup. Permanently install a small funnel on one of the radiator supports and run a length of hose from it to a hole drilled in the water-jar cap.



To prevent rusting out along door bottoms, probe the drain holes occasionally with a screwdriver. It won't hurt either, if you find them plugged, to drill additional holes. Use a $\frac{1}{4}$ " drill and space the new holes in the door between the old ones.



Bridge the gap between the floor mat and door molding to make sweeping out the car an easier job. Cut pieces of stair tread and slip them under the mat, leaving an inch or so protruding over the metal to deflect the sweepings up and out.

Favorite Short Cuts to the Junk Yard



What's your worst driving habit? What's your neighbor's? Inspectors for National Bonded Cars, Inc., were asked to list bad-driving habits that cause wear. Here are the survey leaders

- **Jack-rabbit starts.** Wears transmission, drive shaft, rear axle, and tires.

- **Unnecessary fast stops.** Wears tires and brake linings. Strains front shocks.

- **Riding the clutch.** Wears the clutch-release bearing and disk facing, causing slippage, which also wastes gas.

- **Riding the brakes.** On automatic-transmission cars, using the new wide brake pedal to rest the left foot wears brake lining and overheats transmission.

- **Bumping front wheels against curb.** Throws alignment out, breaks tire walls.


- **Fast cornering.** Wears tires, shocks and springs. Strains steering linkage.

- **Driving too fast on rough roads.** Damages shocks, springs, tires, transmission, frame and body alignment.

- **Braking with transmission.** Fine on a steep hill, but downshifting at every stop to save brakes strains an automatic transmission and wastes gas.

- **Spinning wheels on gravel or ice.** Quickly ruins transmission, wears rear tires, wastes gas.

- **Neglecting maintenance.** Low oil level causes engine friction, wears bearings. Low coolant level causes overheating, warped valves, seizing of engine parts. Low tire pressure hastens wear.



Auto Upkeep

What Is a Tune-Up?

Cleaning and adjusting your engine to put it in top shape could cost as much as \$40. Here's what you should know to get your money's worth

By William Carroll

MOST mechanics are ready to tell you your car needs a tune-up. But few agree on what's included or how often it should be done.

It's no wonder they're confused. Plymouth's tune-up chart includes a fuel-pump test and head-bolt tightening. Chevrolet passes over both and suggests checking the coil and cooling system. The

Ford factory manual recommends a vacuum gauge for adjusting carburetors, but a tachometer is the thing with Buick.

Webster defines tuning-up as "making the fine adjustments which are necessary to bring an engine into first-class running condition." But what are these fine adjustments? How do you know when they're needed?

All mechanics agree that there are two types of tune-ups: a minor tune-up, which

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**BODY
SHEEN**
by **SIMONIZ**

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without a wash job



New
HIGH-DRY SHINE
for cars

New BODYSHEEN gives car a HIGH shine, brighter than any paste wax. Thick-liquid cleaning and polishing agents leave the car dazzling.

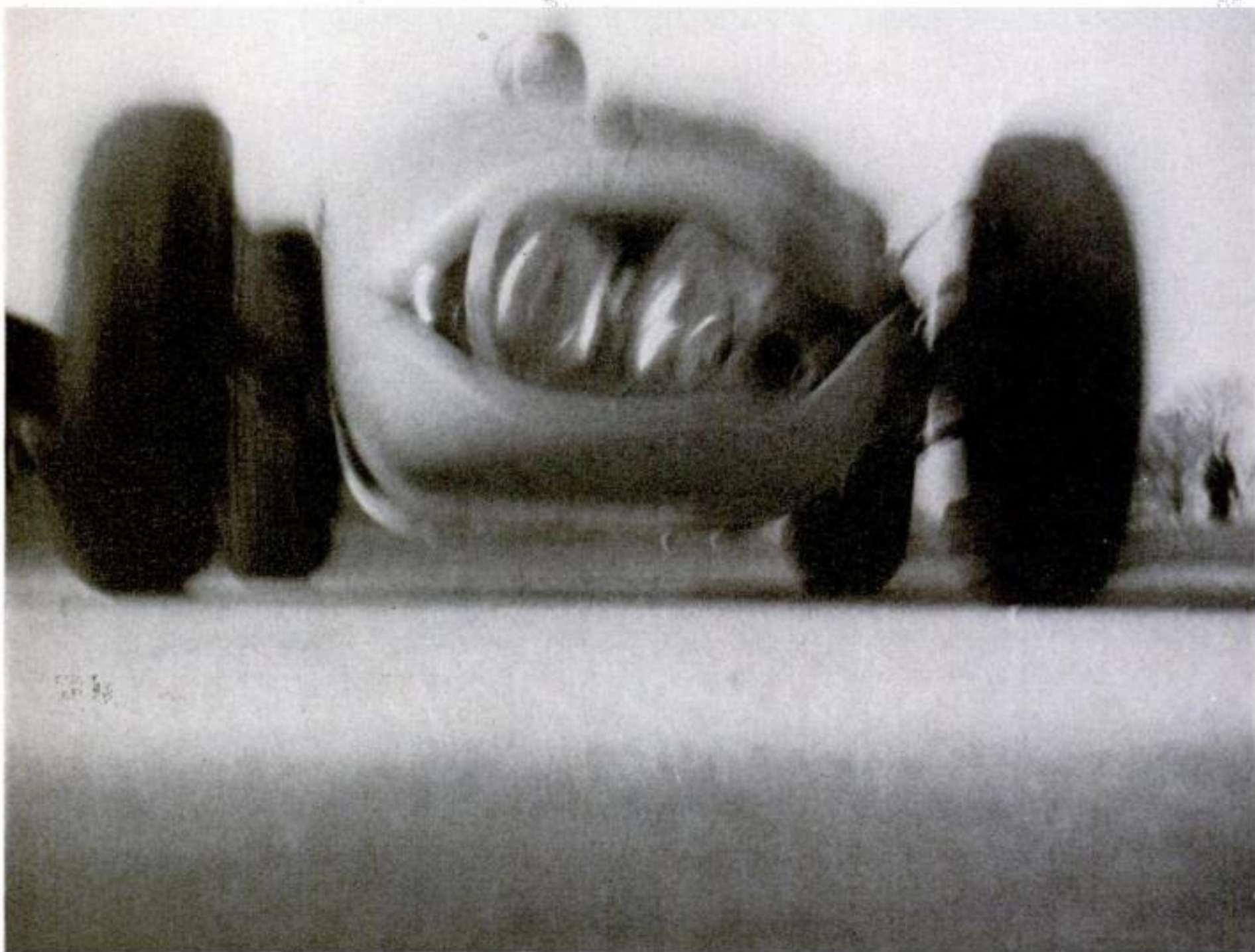
New BODYSHEEN gives car a DRY shine. It takes off normal dirt, dust, road grime . . . there's no need to wash your car first.

New BODYSHEEN gives your car like-new sparkle and color. Restores original lustre to the finish. Makes faded colors glow like new. Bodysheen is ideal for all the newest car colors and finishes, too.

.....

DIRECTIONS: Shake can well. Pour small amount of Bodysheen on cloth and wipe well on car. Let dry to a haze. Wipe off with soft cloth.

NOW — \$1.49



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Q. Why have 7 of the last 8 Indianapolis winners been powered by Champion spark plugs?

A. Champions give full-firing power. Put new Champions in your car every 10,000 miles. You'll get an *immediate* boost in horsepower...and save gasoline, too!



World's favorite spark plug—engineered for every car built by Ford, General Motors, Chrysler, American Motors, Studebaker-Packard and every major foreign maker

CHAMPION

is a once-over-lightly to make a good engine run better, and a major tune-up, which is a thorough testing and, when necessary, reconditioning of the engine components that affect performance. But there is not always full agreement on the

What are the steps in a tune-up?

Here are the service operations most commonly listed for each type of tune-up:

MINOR

- Clean and adjust spark plugs
- Adjust distributor points
- Reset ignition timing
- Adjust carburetor idle

MAJOR

- All items in the minor tune-up plus replacement of spark plugs and points, if necessary
- Tighten cylinder heads, manifolds and hose connections
- Check compression in all cylinders
- Check manifold heat control and free, if necessary
- Clean air cleaner, oil filler cap and fuel-pump filter bowl
- Check engine vacuum and adjust carburetor. Clean carburetor if necessary
- Adjust fan belt and check condition
- Check and adjust generator output and voltage regulator
- Check coil and condenser
- Check battery condition; clean and tighten terminal connections
- Adjust valves (if mechanical tappets)

details of what you should get with each.

Will any engine gain from tuning? That depends. If it runs at all, a minor tune-up usually will make it run better. But if compression isn't fairly equal in all cylinders (this is checked early in a major tune-up) no amount of tuning will make the engine run smoothly until the cause is corrected. Have the mechanic show you compression readings and estimate the cost before giving him the go-ahead on repairs. Adjacent cylinders reading lower than the others may be faulty because of a gasket leak between them (least expensive repair). A low reading in one cylinder usually can be traced to a burned or sticking valve (moderately expensive), but if a teaspoon of oil poured into the spark-plug hole seals the leak and brings the compression up to par, a ring job is indicated (well over \$100 on V-8 engines).

How much should it cost? Labor alone for a minor tune-up on a six-cylinder engine will cost around \$5 to \$8.50. A major tune-up on an overhead V-8 can stand you up to \$40, including the parts usually replaced. You can check the basic labor cost of any tune-up by phoning several new-car dealers for a quotation before taking the car in, but parts costs depend largely on the seller's conscience.

How often should a car be tuned? Oldsmobile specifies a tune-up each 8,000 miles or once a year, while Plymouth says 3,000, Cadillac 4,000, Chevrolet 5,000, and Ford every 6,000 miles. But no two engines wear at the same rate. That's because driving habits vary. So scheduling tune-ups by mileage alone can be wasteful. If your car seems to run okay and an \$18 tune-up adds only one mile per gallon, you'll have to drive about 15,000 miles to pay for it with savings in gas.

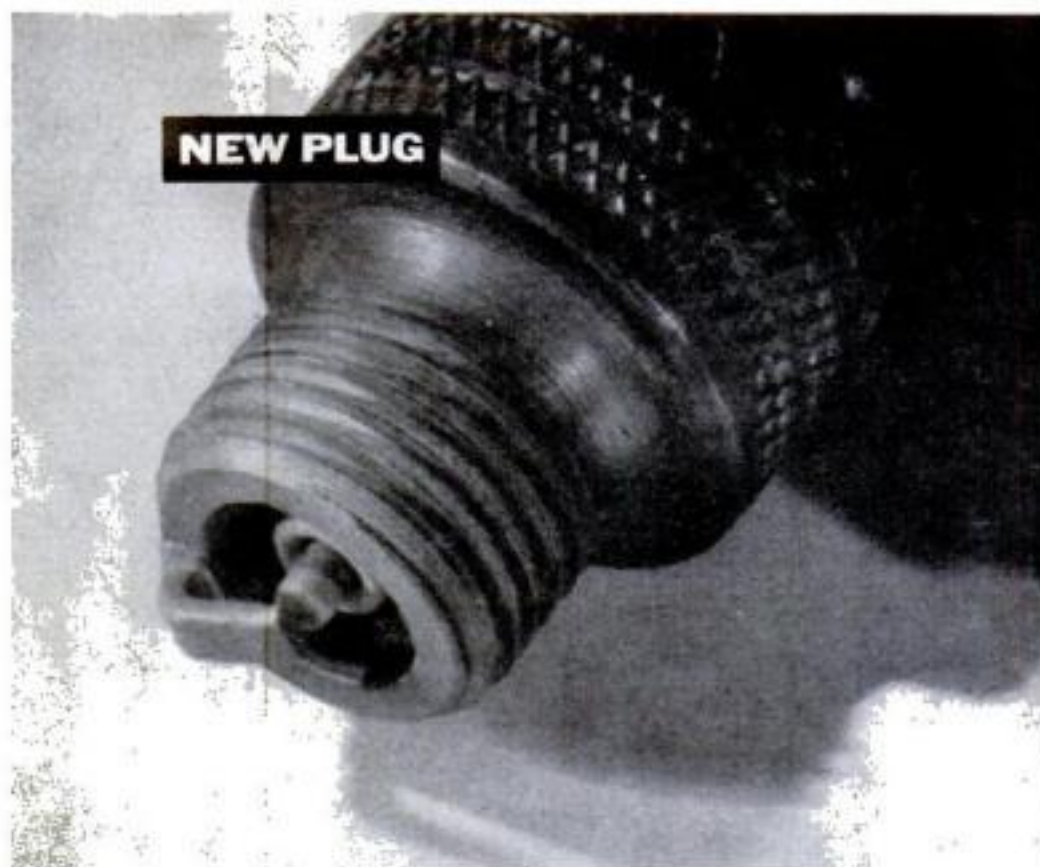
A better way is to know and watch for the signs that tell you when a tune-up is about due. The signs are positive and easy to spot, either by inspecting the engine or by observing its performance. Unfortunately, engine performance slips so gradually most of us don't feel it going until it's time for a major tune-up. By that time performance is so bad almost anything will make for improvement.

Are there any "tricks" to tune-ups? Dozens. Most common is "boiling the carburetor." At a reliable shop the carburetor is taken apart, cleaned and rebuilt

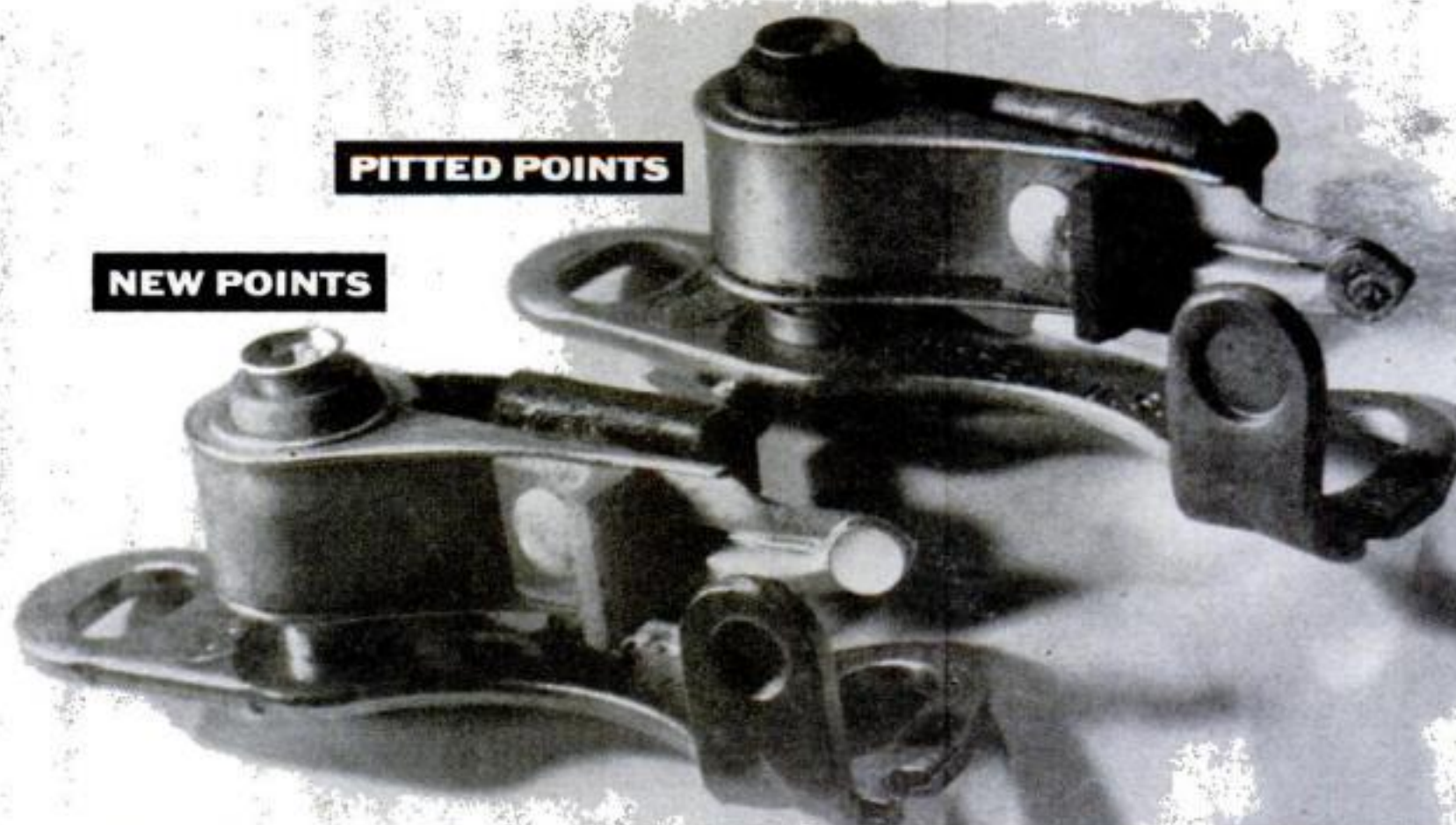
Signs that your car needs a tune-up

A 10-MINUTE inspection with only a screwdriver and a spark-plug wrench will tell you your engine's condition. Look for dirty or oil-fouled plugs; plugs with electrodes partly eaten away; points that are deeply pitted, dirty or burned; cracked or frayed ignition wires; a heavy coating of red fuel stain or gum inside the carburetor's throat; and a rough-idling engine.

Any combination of these signs indicates the need for a minor tune-up. If, in addition to the visual signs, the car performs sluggishly, stalls at traffic signals, gasps for fuel when accelerated or bucks on an uphill pull, you'd better have a major tune-up. As a general rule, every third tune-up should be a major one.



PLUGS TELL A BIG STORY. More than any other engine part, spark plugs reflect the general condition of an engine. The by-products of combustion—carbon and lead-oxide deposits—

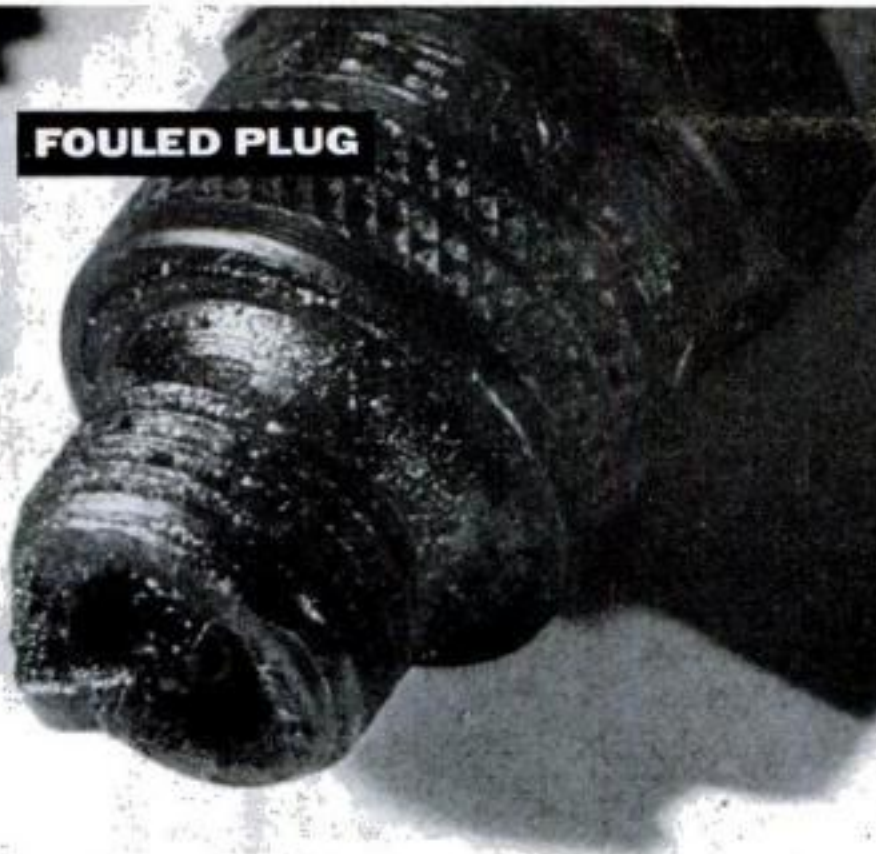


CONDITION OF BREAKER POINTS also tips off the need for a tune-up. If they appear sooty, or if there is black dust on the plate beneath them, they need cleaning and gapping. If their surfaces are slightly rough, they are service-

able, but probably need light cleaning and setting. A deep pit or hole on one point opposite a mound on the other (as above, at right) indicates that the points *and* the condenser should be replaced with a new set.

with a packaged kit of new parts, if needed. But often the whole assembly is dunked in cleaner and reinstalled with nothing more than a 12-cent manifold gasket. Few factory manuals recommend carburetor rebuilding as a routine part of

a tune-up because, as one fleet superintendent put it, "If the carburetor responds to adjustment we leave it alone, for rebuilding a functioning carburetor costs far more than the little we gain in better gas mileage."



FOULED PLUG



WORN PLUG

build up on plugs over a period of use. Fouled plugs like the one in the center indicate the need for at least a minor tune-up. In time, the spark eats away the electrodes (right) making

the plug difficult to gap properly. Plugs in this condition suggest the engine is overdue for a major tune-up. Compare both plugs with the new, correctly gapped one in photo at left.



DIRTY CARBURETOR

LOOK DOWN THE CARBURETOR'S THROAT and you'll say "aaah!" when you find it coated with red stain and gum from the gas that's gone through it. Only a major tune-up includes cleaning the carburetor jets and passages.



CRACKED WIRES

HIGH-TENSION WIRES in this deteriorated condition must be replaced to make an engine perform well. Lift the hood some dark night and watch the engine idle; you'll actually see sparks leaking from cracked or oil-soaked wires.

Unnecessary replacement of breaker points, condenser and spark plugs also can pad a tune-up bill considerably. The Delco-Remy service manual states specifically, "Points which have undergone several thousand miles of operation will have

a rough surface, but this should not be interpreted as meaning the points are worn out. A large contact area is maintained because roughness between the points matches so well. Such points continue to provide satisfactory service until

.....

How they tune up Sgt. Friday's car

IN THE Los Angeles Police Department, some 750 cars travel more than 16,000,000 miles a year. Says Transportation Superintendent Ray Wynne:

"We give each car a minor tuning every 6,000 miles, clean and gap usable spark plugs, discard those that miss at high speed and install new breaker points when we install new plugs."

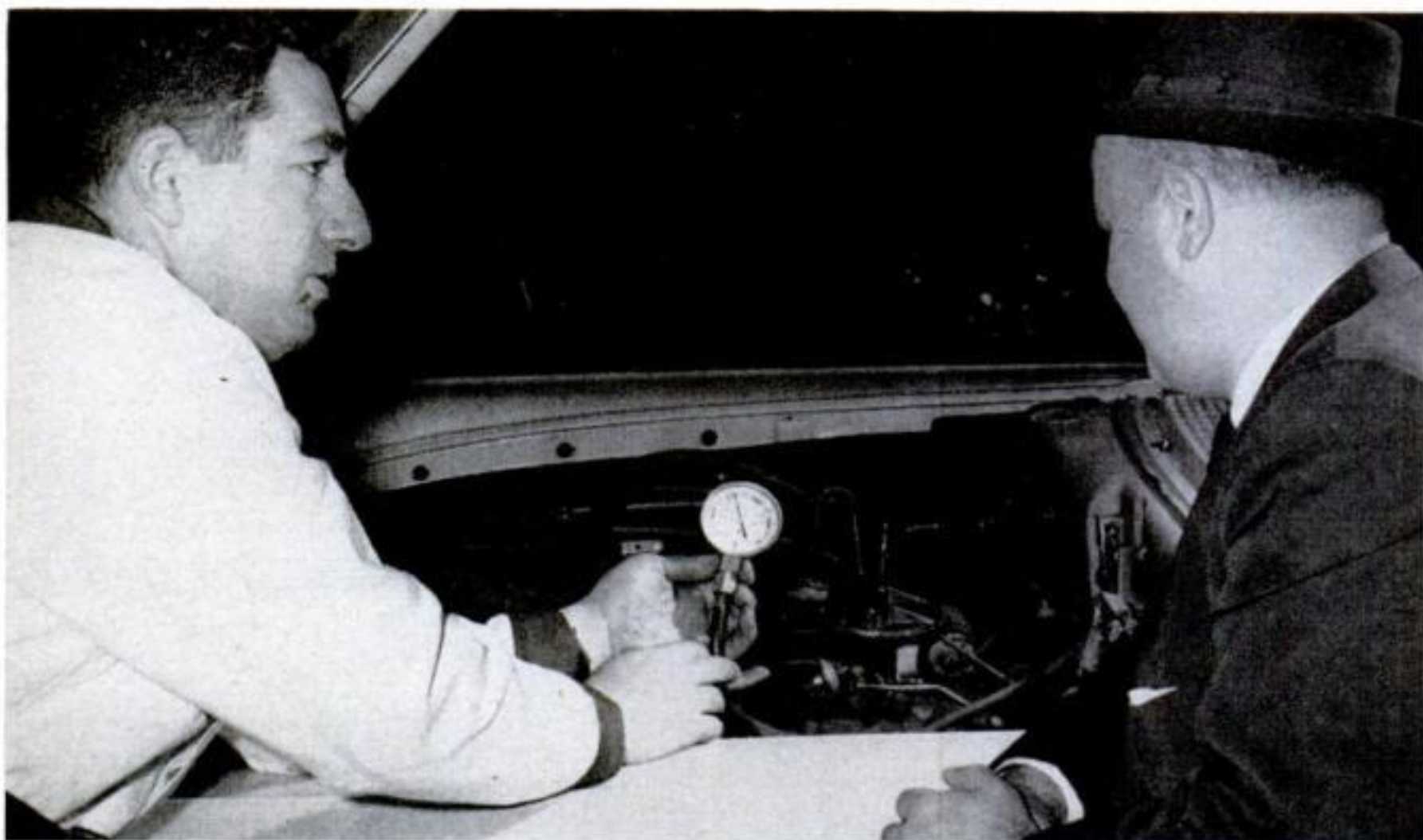
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most of the tungsten is worn off. However, if the points burn or have deep pits they will soon become unsatisfactory and should be replaced. But new points will provide no better service than the old, unless the *cause* of the burning or pitting is corrected. Rapid failure of points results from high voltage, presence of oil or dirt, improper adjustment or a defective condenser." Unfortunately, few mechanics take time to determine *why* points burn. It's too easy to make a noticeable immediate improvement simply by installing a new set.

The installation of rebuilt spark plugs, or reinstallation of your old ones after careful cleaning, while charging for new plugs is a common trick to watch out for.

A reputable community shop will inspect plugs and points and, if in usable condition, charge you only for the labor of cleaning and resetting them. Such a shop has a personal interest in your satisfaction that is more valuable than a few dollars saved by shopping around for the lowest price.

After the job is done, take 10 minutes for an inspection to satisfy yourself that you've actually received all the new parts that were charged on your bill. You'll have little trouble distinguishing new parts from cleaned-up old ones. Rebuilt plugs are especially easy to spot: The metal shell, normally blue-surfaced steel, is invariably painted black to conceal rust or old wrench marks.



COMPRESSION CHECK usually is the first step after the spark plugs are removed, although many mechanics will skip it when doing a minor tune-up on a late-model car. It is done by pressing a rubber-nippled compression gauge in each

spark-plug hole in turn and cranking the engine an *equal* number of times for each cylinder tested. If one or two cylinders read more than 15 pounds lower than the others, it's a tip-off that mechanical repairs are needed. **END**



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MAY 1958 197

Gus Meets



*"That's what I get,"
Cosgrove said angrily,
"for listening to
an apple-knocker
mechanic like you."*

By Martin Bunn

WHEN a passing motorist notified Gus Wilson that a man 10 miles down the highway needed a rental battery, the burly proprietor of the Model Garage immediately went to the rescue. Pulling up before the stalled car, Gus swung down from the cab with a 12-volt battery swinging on a carrying strap. The motorist, a youngster of about 20, greeted him cheerily.

"About time, Pop," he said, reaching for the battery. "Here, let me take that. It's a bit on the heavy side for you."

Gus was so astonished that he relinquished his grasp on the battery. "The name," he said, "is Gus Wilson. Model Garage."

"Never heard of the joint, Pop," the young fellow said as he raised the hood of his sedan, whipped a wrench and battery pliers from his pocket, and began making the battery exchange.

Gus leaned over his shoulder to glance at the date-of-sale stampings on the lead cell connectors of the car's battery.

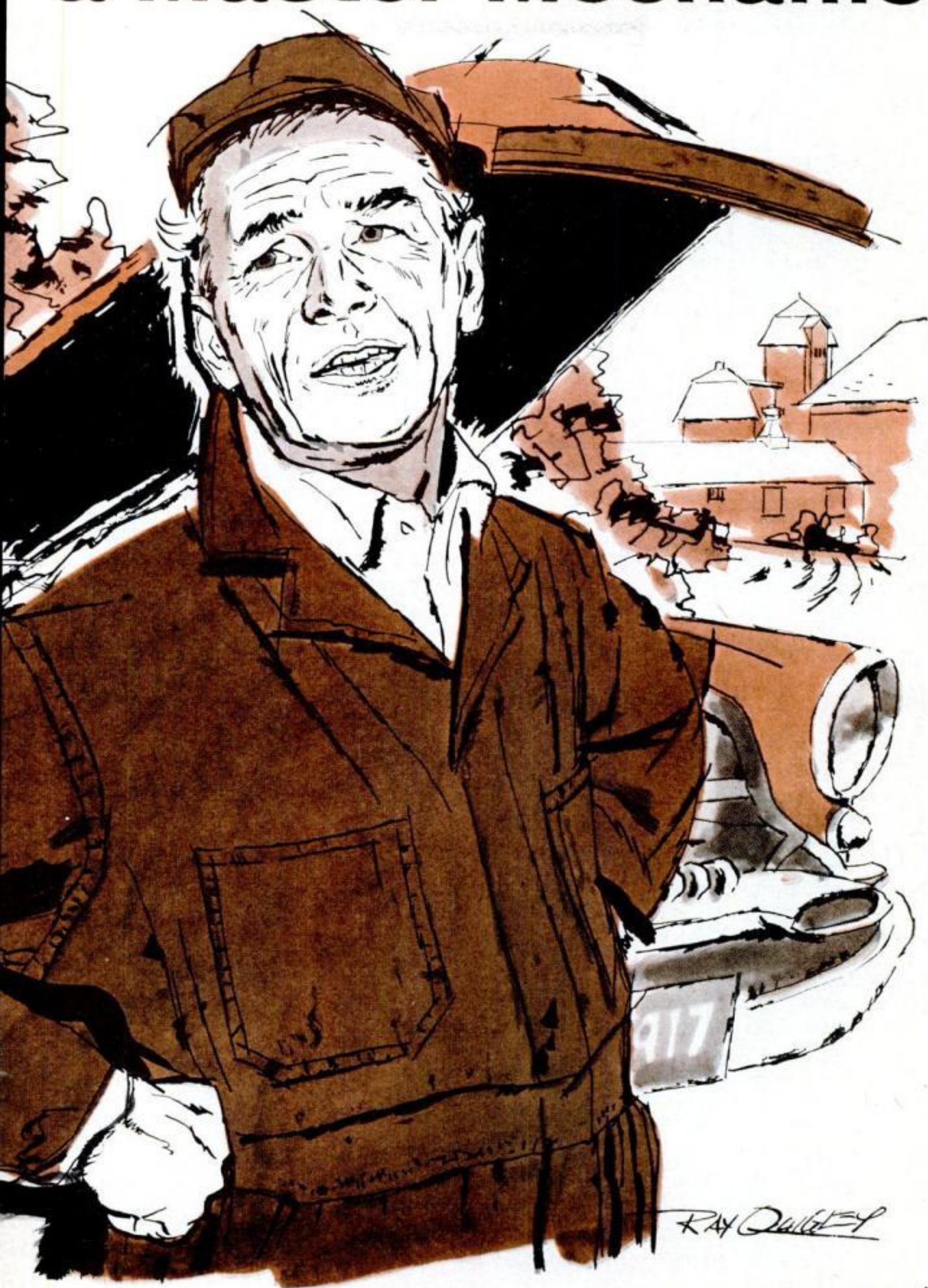
"This battery shouldn't have failed after only a year," he said. "There must be a short in your wiring or a defective generator."

"You just leave that to me, Pop," the young man said briskly. "After my motor went dead I ran the battery down trying to start it. I knew what was wrong, of course, but hoped to get it going long enough to pull over the next rise, so that maybe I could coast down nearer a service station or telephone."

"I see," Gus said. "What is wrong?"

"Blown condenser. Any mechanic could tell that, and I've had

a Master Mechanic



four years' experience in big-time garages in the city. It would be hard to explain to the layman, but the action of the condenser is very important. If you have a blown condenser the spark is too weak to jump across the spark-plug electrodes against compression. Say, I hope the Model Garage sent out a condenser for this model car. If not, you'd better rustle your bones back to town after one. I'm due to report on the job right away."

"What job?" Gus asked.

"Oh, didn't I tell you? I'm Fred Cosgrove—sent out from the city to take charge of the mechanical work for the Henderson Construction Company. They're a big outfit that's building homes in a new subdivision in the town. I'm to take care of their equipment, sort of a master mechanic's job. An outfit like Henderson's couldn't have apple-knocker mechanics fooling with their expensive machinery."

"Yeah," Gus said, as Cosgrove finished the battery exchange. "I know Matt Henderson. Pretty big outfit."

"That's what I hear," Cosgrove said. "By the way, what's your job with this Model Garage outfit, Pop?"

"Oh," Gus said, "I do just about anything that comes to hand."

"I see," Cosgrove said. "Sort of handyman about the joint. Now how about a condenser for this rig?"

A FLICKER of amusement came to Gus's eyes as he said, "The Model Garage only sent a battery out with me. But I just happen to have a condenser, too. Now, where did I see it last?"

He rummaged around in the service truck and brought out a condenser.

"That one won't do," Cosgrove snapped. "It's too big. You couldn't fit that thing inside my distributor with a hammer. You'd better hustle back to town and get one made for this car."

"No use in that," Gus said. "I can tow you in as I go."

"Oh, no you won't!" Cosgrove exclaimed. "Wouldn't it look pretty for the new master mechanic for the Henderson Construction Company to be towed into town because he couldn't fix his own car on the road!"

"I never thought of that," Gus admitted. "A fellow like you does have to watch out for his reputation. Say, couldn't

you just sort of stick this condenser to the side of the distributor, or maybe hang it on the coil, and tie the wires to it? It doesn't have to be inside the distributor, does it?"

"Well now," Cosgrove said, "come to think of it, it might work that way long enough to pull me into town."

"Let's try it," Gus said.

COSGROVE managed to attach the condenser to the side of the distributor by using one of the screws that fastened the breaker plate and connected the condenser lead to the primary wire terminal. The motor started instantly and ran smoothly.

"I'd better get this battery of yours on the line," Gus said as he climbed into his service truck. "You can follow me in and have the right condenser installed. The Model Garage is on West Main Street."

"I'll find it," Cosgrove said, glancing at his watch. "I'll be stopping on the way in for lunch. I'm hungrier than a dog."

Gus drove away with a frown on his face. "Pop!" he repeated to himself. "Give me that battery, he says, it's too heavy for you, Pop!"

Gus had been at the Model Garage for about an hour when Fred Cosgrove phoned.

"Model Garage?" he said. "This is Cosgrove, the man you sent that battery out to a while back. Get Pop out here again, and this time see that he brings the right condenser to fit my car. The one he brought last time went out. I had to walk a mile to a farm to telephone."

"Be right with you, Mr. Cosgrove."

Gus found young Cosgrove parked on the highway shoulder with the hood raised.

"That's what I get," he declared angrily, "for listening to an apple-knocker mechanic like you. That phony condenser blew out within two miles. I haven't got enough spark in this rig to see in a coal mine."

"No spark at all?" Gus asked. He turned the ignition on, leaned over the motor, pulled the high-tension wire from the distributor and removed the distributor cap. Holding the secondary ignition wire close to the engine block, he snapped the exposed ignition points with his thumb. Nothing happened.

"Even with a blown condenser," Gus

said, "I should see at least a weak spark, reddish instead of blue, with no snap or jump to it. I'd say you've got a bad coil, not a blown condenser."

"Is that so?" Cosgrove said. "And how do you account for the fact that my coil was all right just a couple of miles back?"

"Well," Gus said slowly, "such things do happen. Sometimes when you put a fully charged battery and a new condenser on an old coil, the coil goes blooey. Like when you put a new set of batteries in a flashlight. A light bulb that might last a

"You haven't got any more spark here than a dead buzzard," he declared. "You need a new coil. I'd better tow you in."

"You aren't going to tow me anywhere," Cosgrove said. "And why haven't you got a new coil with you? What kind of a screwball outfit is this Model Garage?"

"Usually they send everything I might need," Gus said. "But you telephoned that all you needed was a condenser. Naturally, knowing that you were a master mechanic..."

"Knock it off, Pop," Cosgrove interrupted, "and get into town after a coil. I'm in a hurry."

"Not so fast," Gus replied. "It doesn't seem to me that this coil is old enough to have gone out completely. Now, this 12-volt coil of yours is basically a six-volt coil with a replaceable resistor in the bottom to cut the voltage in half. I'll bet you the best dinner in town that all that's wrong with the coil is that the resistor is burned out. Often such coils are thrown into the trash can by mechanics who don't know that they do contain an

easily replaced resistor. We could pull the cover from the bottom of the coil, which covers the resistor, remove it, if it's burned out, and put the primary-circuit wires together. You'd run then, but you'd soon burn up your ignition points. As it is, I just happen to have a new resistor for this coil with me."

"Just happen, eh," Cosgrove said, his eyes suddenly wise with wry humor. "Maybe I'm not as far out in the sticks as I thought. Fix it, Pop. And I hope you're not as hungry as I am, because I've got a hunch I'm buying your dinner."

"The best dinner in town, mind you," Gus chuckled. He removed the burned-out coil resistor, installed the new one, started the car. "You know, Cosgrove, us apple-knocker mechanics are always hungry."

END

NEXT MONTH: Gus eases a traffic jam.



"Make it snappy—I wanna take a shower, too."

long time with the weak batteries blows out under the load of the new."

"Flashlights aren't automobiles, Pop," Cosgrove said. "Here, give me that new condenser." Swiftly Cosgrove installed the new condenser, buckled down the hood, got into the car. "See you in town, Pop," he said as he turned on the ignition, engaged the starter. When the motor failed to start, he kept engaging the starter, a baffled expression on his face.

"Better cut that out," Gus cautioned as he raised the hood, "or you'll run the battery down. Leave the ignition on."

ONCE again Gus pulled the high-tension wire from the distributor, removed the distributor top, held the secondary wire close to the engine block, snapped the ignition points with his thumb.

10 Offbeat Uses for Soap

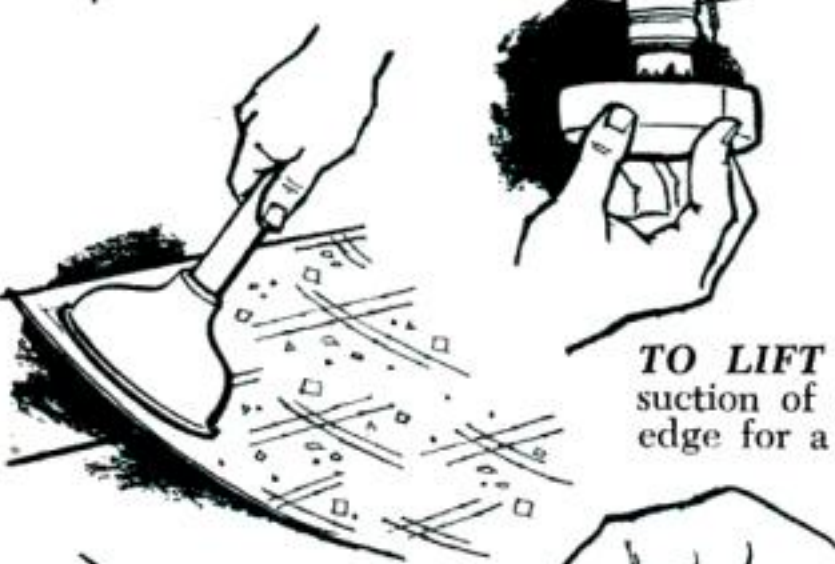


COAT THE SCREW THREADS of a glue container with soap and the cap won't stick fast.

PICK UP GLASS SPLINTERS by rubbing a damp bar of soap over the area where glass has broken. Then shave off the surface of the soap.



DIG YOUR FINGERNAILS into a bar of soap before you begin a painting job, working soap under the nails. Saves difficult under-the-nails cleanup after you've finished.



PLUG A LEAK in a gasoline or home fuel tank, till you can fix it, by jamming soap into the hole.

REMOVE THE BASE of a broken lamp bulb from the socket by pressing a bar of soap against the jagged edge and turning it counterclockwise. But first, be sure the current is off.



TO LIFT LINOLEUM from a tight-fitting corner use the suction of a plumber's plunger. First rub soap on the plunger edge for a tight grip.

WHEN WORKING WITH HARDWOOD, use soap to lubricate all nails and screws that you drive.



TO SOFTEN NEW ROPE, soak it in soapy water for about five minutes before you use it.

COAT BOTH SIDES OF A SAW with soap and the cutting edge will go through wood easier.

TO SAVE CLEANUP when you paint, rub a moist bar of soap over doorknobs and other hardware before you begin. Then paint spatters can be washed away afterward.

HI-FI DICTIONARY

The POPULAR SCIENCE Hi-Fi Dictionary is published in the interest of re-establishing communications between two sectors of the American public—the hi-fi haves and the hi-fi have-nots. The rapid growth of the haves is an accepted fact of mid-20th Century life. But the newcomer who presents himself, checkbook in hand, for admission to the ranks, meets a formidable language barrier. The words *sound* like English. Most of them have ordinary, everyday uses. But the mysterious current of understanding that flows when insiders use them only baffles and frustrates the outsider.

The standard dictionaries have not yet met the need for adequate definitions in this rapidly growing part of the language. The vocabulary offered here is not exhaustive, but it is a key to a working knowledge. Thus equipped, the reader can step fearlessly into any hi-fi store, confident of making himself understood.

A

a-cous'tics (ŭ-kōōs'tics), *n.* The branch of physics that treats of the phenomena and laws of sound. 2. The properties of an auditorium or room that add individual character to sounds heard in it. 3. A handy villain to blame any time a hi-fi system doesn't sound right.

A.F. (ā-ēf), *n.* Short for audio frequency. 1. A vibration at such a rate that it is audible, usually considered as ranging from 20 to 20,000 cycles per second. 2. An electrical voltage or current alternating at a frequency in the same range.

A.F.C. (ā-ēf-sē), *n.* Short for automatic frequency control; an electronic circuit in an F.M. tuner used to make tuning simpler and to compensate for any tendency of the receiver to drift off-tune.

A.M. (ā-ēm), *n.* Short for amplitude modulation; the form of transmission used on standard broadcast radio, such as that picked up by the ordinary kitchen set.

amp. (āmp), *n.* 1. Short for amplifier; used in compounds, such as pre-amp for pre-amplifier (q.v.) or power-amp (see basic amplifier). 2. Short for **am'pere** (am'pēr), a unit used for measuring electrical current.

au'di-o (aw'dē-ō), *n.* 1. The electrical voltages and/or currents that, after amplification, will cause a loudspeaker to deliver sound. 2. Syn. for "sound" in audiophile vocabulary.

au'di-o-phile' (aw'dē-ō-fil'), *n.* A person to whom listening to hi-fi is a way of life.

B

back'loaded horn (băk'lōdēd hawrn), *n.* A loudspeaker enclosure arranged so the sound from the front of the cone feeds directly into the room, while the sound from the rear feeds into the room via a folded horn.

baf'fle (băf'fūl), *n.* Any structure for holding a loudspeaker that prevents low-frequency sounds produced by the back of the speaker cone from canceling those produced by the front of the cone.

ba'sic am'pli-fi-er (bā'sik ām'plī-fī-ūr), *n.* An electronic unit that takes audio input from a tuner or pre-amplifier and provides power to drive the loudspeaker. Also called power amplifier. **Low-pow'er a.:** (up to 12 watts) sufficient to produce loud sound in owner's living room. **High-pow'er a.:** (25 watts and up) sufficient to produce loud sound in living room a block away.

bass (bās), *n.* 1. Musical tones corresponding with a rate of vibration lower than 260 per second (played in the bass clef). 2. Audio in the frequency range delivered by the crossover (q.v.) to the woofer (q.v.).

bass re'flex (bās rē-flēx), *n.* 1. A loudspeaker enclosure in which radiation from the rear of the cone is allowed to escape through a hole (or port) in such a way as to augment the lowest tones. Also called **port'ed re'flex** or **vent'ed re'flex**. 2. A peremptory challenge to an advocate of horn-type enclosures.



bi'as (bī'ūs), *n.* 1. An operating voltage (for tubes) or current (for transistors) that fixes the correct performance characteristics. 2. An affliction suffered by most audiophiles that colors their opinion of components other than the ones they use.

bin-au'ral (bīn-aw'rūl), *adj.* Pertaining to equipment or sound that makes use of the human faculty of hearing independently with each ear.

boom (bōom), *v., n.* Accentuation of one of the bass tones, by resonance (q.v.).

C

ca-pac'i-tor (kā-pās'i-tūr), *n.* An electronic part that permits audio or other AC currents to flow through it while blocking current from DC operating voltages.

car'tridge (kar'trij), *n.* See pickup.

cath'ode (kāth'ōd), *n.* The part of a tube

that provides electrons, usually by being heated.

cath'ode fol'low-er out'put (-fōl'lō-ŭr out'put), *n.* A circuit feature used mainly in pre-amplifiers and tuners to avoid loss of high frequencies and minimize hum pickup in the connecting cable to the power amplifier.

ce-ram'ic pick'up (sēh-rām'ik pik'ŭp), *n.* A pickup (q.v.) using a synthetic piezoelectric (q.v.) element which is resistant to high temperatures and humidity.

chas'sis (shās'ē), *n.* The metal frame on which any piece of electronic equipment (amplifier, pre-amplifier, tuner, etc.) is built.

class A (klās ā), *adj.* A mode of operating an amplifier stage that gives the best linear (q.v.) quality and reliability.

class AB (-ā-bē), *adj.* A mode of operating midway between class A and class B.

class B, *adj.* A mode of operating two tubes or transistors in push-pull that gives the best efficiency (biggest maximum-output potential), usually at some sacrifice of linearity and/or reliability.

clip'ping (klīp'pīng), *n.* A distortion that occurs, mostly in basic amplifiers, when maximum output is reached.

co-ax'i-al speak'er (kō-āx'ē-ŭl spēk'ŭr), *n.* A unitary (q.v.) type in which a woofer and tweeter are mounted together so the sound emerges at the same point, whatever its frequency.



Coaxial Speaker

com'pen-sa'tion (kōm'pēn-sā'shŭn), *n.* Specifically pickup c. (see equalization) or loudness c. (see loudness control).

com-pliance (kōm-plī'āns), *n.* 1. A measure of the ease with which a part needing to move at audio frequencies can do so; opposite of stiffness. Applied to (1) pickup stylus and (2) loudspeaker surround. 2. Low sales resistance.

cross'o-ver (kraws'ō-vŭr), *n.* An electrical or electronic circuit that delivers the various audio frequencies to the proper speakers in a two-way or three-way system.

crys'tal pick'up (krīs'tŭl pik'ŭp), *n.* One using a natural crystal (usually Rochelle salt) for the piezoelectric (q.v.) element.

cy'cles (sī'kŭls), *n.* Contraction from cycles per second; a measure of frequency of electrical impulses or of sound-vibration rate.

D

damp'ing fac'tor (dāmp'ing fāk'tŭr), *n.* A measure of an amplifier's effectiveness in preventing a loudspeaker from oscillating on its own when the audio drive terminates, figured by dividing the nominal loudspeaker impedance by the measured amplifier-output impedance.

dec'i-bel (dēs'ī-bēl), *n.* Abbr. **db.** (dee-bee). A unit for measuring the relative intensity of sound. It is one-tenth of a bel, the fundamental division of a scale for expressing the ratio of two amounts of power.

de-em'pha-sis (dē-ēm'fŭ-sīs), *n.* A process applied in receiving F.M. or playing records, to remove the pre-emphasis (q.v.) applied in transmission or recording.

dis-crim'i-na-tor (dis-krīm'ī-nā-tŭr), *n.* One type of detector for extracting the audio from a frequency-modulated transmission (see F.M.).

Dop'pler ef-fect' (dōp'plŭr ēf-fēkt'), *n.* The change in pitch of a sound due to relative motion of source and listener. Theoretically it occurs in loudspeakers when a low-frequency and a high-frequency sound are being reproduced simultaneously. The low-frequency movement will raise the higher frequency when the cone moves forward and lower it when the cone returns. The practical effect is very small.

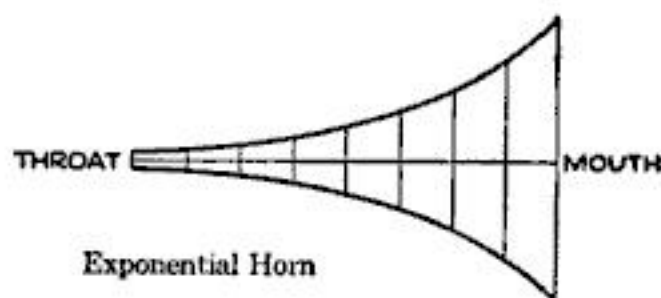
dy-nam'ic mass (dī-nām'ik mās), *n.* The effective weight, or mass, of a moving part. Applied to the stylus assembly of pickups, the tone arm, and the moving parts of loudspeakers.

dy-nam'ic range (-rānj), *n.* The coverage, in decibels, between the loudest and softest audio a system, record or tape will handle (see signal-to-noise ratio).

E

e-lec'tro-stat'ic tweet'er (ē-lēk'trō-stāt'ik twēter), *n.* A variety of tweeter using a large flat diaphragm that is driven directly by a varying high voltage applied between the diaphragm and another electrode.

e-qual-i-za'tion (ē-kwŭl-ī-zā'shŭn), *n.* 1. The use in a sound-reproduction system of a circuit having a frequency response (q.v.) tailored to equalize or compensate for a recording characteristic (q.v.) used in making a disc or tape. 2. The process by which the relative intensities of the high and low frequencies are restored to their original relationship in playing back a record or tape.

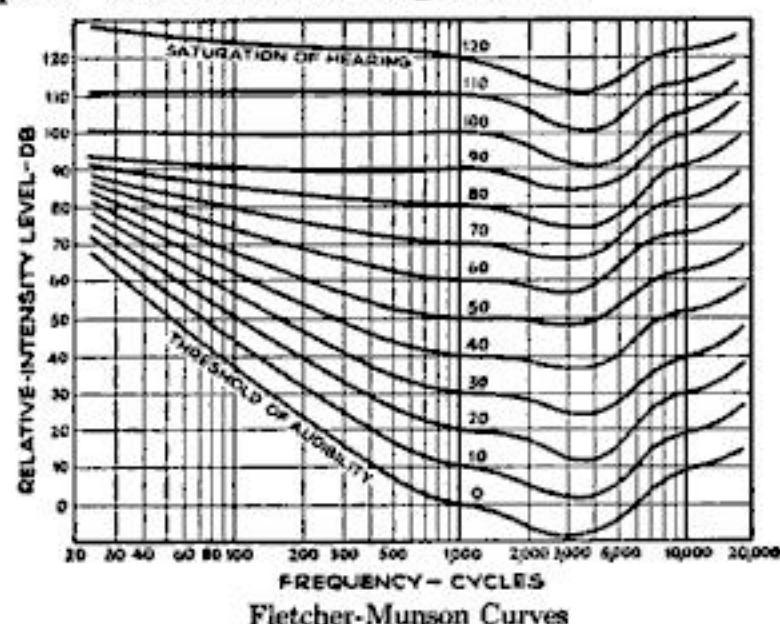


ex-po-nen'tial horn (ēx-pō-nēn'shŭl hawrn), *n.* A horn whose shape is determined by a particular mathematical (exponential) equation. It is generally regarded as giving the flattest frequency response with the least distortion when properly designed and constructed.

F

fil'ter (fil'tŭr), *n.* An electrical or electronic

device that permits certain frequencies to pass while obstructing others.



Fletcher-Munson Curves

Flet'cher-Mun'son curves (flēt'chūr-mūn'-sūn kūrvs), *n.* The original loudness-contour curves. They show the average sound intensity needed to produce different loudness sensations among a number of listeners, over the audio-frequency range.

flut'ter (flūt'tūr), *n.* 1. A rapid fluctuation in speed, either in tape transit or record rotation. 2. The rapid pitch fluctuation produced thereby in the reproduced program.

flux den'si-ty (flūx dēn'si-tē), *n.* Intensity of magnetization, either alternating (audio) or permanent (magnet).

F.M. (ēf-ēm), *n.* Short for frequency modulation. The kind of transmission that is immune to static and achieves the highest possible fidelity in radio transmission.

fre'quen-cy re-sponse' (frē'kwēn-sē rē-spōns'), *n.* A curve indicating the relative response of a system, or part, to the different audio frequencies. Said to be flat when response is uniform to all frequencies.

G

gain con-trol' (gān kūn-trōl'), *n.* A control for adjusting the amplification of a system. Sometimes called level or volume control (q.v.).

groove (grōōv), *n.* An indented track in a phonograph record that transmits audio vibrations to the pickup stylus.

H

har-mon'ic dis-tor'tion (har-mōn'ik dī-stawr'shūn), *n.* A form of distortion, produced by any part of a hi-fi system, that results in overtones (q.v.) of improper audio frequencies. Also called **non-lin'e-ar dis-tor'tion**.

hiss (hīs), *n.* A sound like escaping steam that can be due to a variety of causes (see noise).

horn cut'off fre'quen-cy (hawrn cūt'awf frē'kwēn-sē), *n.* A frequency below which a horn will not function correctly, because it fails to provide for proper expansion of the sound waves (see exponential horn).

hum (hūm), *n.* 1. A low-pitched sound due to the AC power-line frequency—or some by-

product of it—getting into the audio. 2. A handy signal that the set is turned on, if the hum defies all repair efforts.

hys'ter-e'sis syn'chro-nous mo'tor (hīs-tēr-ē'sis sīn'krō-nūs mō'tūr), *n.* A kind of electric motor used for driving turntables, having the merit that its constancy of speed is fixed by the supply (line) frequency.

I

im-pe'dance (īm-pē'dūns), *n.* A quantity analogous to resistance (also measured numerically in ohms), that determines the relationship between voltage and current in an audio circuit. **High im-pe'dance**, *adj.*: Applied to a circuit where the audio voltages cause negligible (if any) audio current to flow. **Low im-pe'dance**, *adj.*: Applied to a circuit where measurable audio current accompanies an audio voltage (the impedance in ohms determining the relationship).

im-pe'dance match'ing (-māch'ing), *n.* The combining of circuits in which impedance values satisfactorily correspond.

in'fi-nite baf'fle (īn'fī-nīt bāf'fūl), *n.* 1. Hypothetically, an infinitely large board with a hole in it, in which a loudspeaker is mounted. 2. A totally sealed enclosure, except for the hole to receive the loudspeaker.

in'ter-mod'u-la'tion dis-tor'tion (īn'tūr-mōd'ūl-lā'shūn dīs-tawr'shūn), *n.* Any of a variety of distortions that occur from interaction among the different frequencies in an audio program.

L

lab'y-rinth (lāb'ī'rīnth), *n.* A type of speaker enclosure in which a folded passage, coupled to the back of the speaker cone, is designed to improve the bass performance of the speaker.

lev'el con-trol' (lēv'ūl kūn-trōl'), *n.* A control intended mainly to ensure that each part of a system works at its best, by careful initial adjustment; not intended to control volume (see volume control).

lin'e-ar (līn'ē-ūr), *adj.* 1. Characterized by absence of harmonic or intermodulation distortion (q.v.). 2. Characterized by having a flat frequency response (see frequency response). 3. Characterized by amplifying a "quiet" program in uniform proportion with a louder program.

loud'ness con-trol' (lowd'nēs kūn-trōl'), *n.* 1. A control that automatically boosts the bass when the program is played at low volume. This is supposed to restore a natural balance to the sound that is lost because the ear is less sensitive to low frequencies when volume is low. 2. An unsympathetic spouse.

loud'speak-er ef-fi'cien-cy (lowd'spēk-ūr ēf-fish'ūn-sē), *n.* An approximate indication of the audio power a loudspeaker requires to give adequate sound output.

loud'speak-er en-clos'ure (-ēn-klōs'yūr), *n.* The cabinet housing a loudspeaker, part of its function being to contribute to speaker performance.

loud'speak-er sys'tem (-sīs'tēm), *n.* A complete speaker assembly, consisting of a number of loudspeaker units mounted in their enclosure.

M

mag-net'ic pick'up (măg-nēt'ik pīk'ŭp), *n.* A form of phonograph pickup that uses the stylus movement to change the magnetic field around a fixed coil and thus produce audio voltages.

mi'cro-groove (mī'krō-grōōv), *n.* Name given to any disc record with a groove designed for playing with a 1-mil stylus having a radius at its "point" of .001".

mo'tor-boat'ing (mō'tŭr-bōt'ing), *n.* Spurious audio generated internally by malfunctioning of an amplifier and characterized by a plop-plop sound from the loudspeaker.

mouth (mowth), *n.* 1. The large end of a horn, which delivers sound into the room. 2. A source of distraction accompanying non-hi-fi visitors.

mov'ing coil (mōōv'ing kōil), *adj.* or *n.* 1. Applied to a pickup where the stylus moves a minute coil in a magnetic field, producing audio voltage. 2. Applied to a loudspeaker where the audio is fed to a coil free to move and drive the cone.

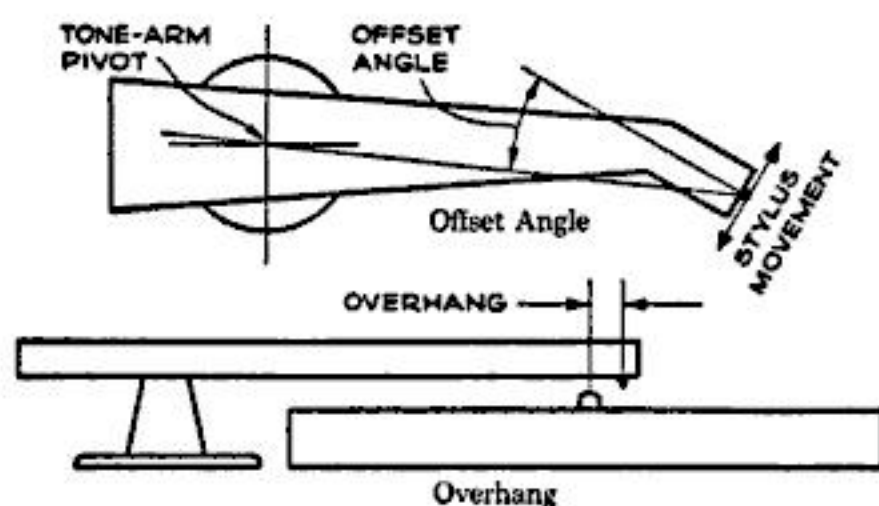
N

neg'a-tive feed'back (nĕg'ŭ-tiv fĕd'băk), *n.* An electronic process of sampling the audio output, comparing it with the input, and using the result to improve the performance of the system.

noise (noiz), *n.* Any form of unwanted audio or sound not related to the program content.

O

off'set an'gle (awf'sĕt ăn'gŭl), *n.* The angle between the axis of the pickup and an imaginary line from stylus to tone-arm pivot.



o'ver-hang (ō'vŭr-hăng), *n.* The critical dimension by which the stylus overreaches the center spindle of a turntable when an offset tone arm is mounted for minimum tracking error (q.v.).

o'ver-tone (ō'vŭr-tŏn), *n.* 1. (mus.) A frequency that approximates an integral multiple of the one responsible for the pitch played, and which contributes to the *timbre*

of the instrument. 2. (audio) An exact frequency multiple, either generated deliberately, as in an electronic organ, or in error, as in harmonic distortion (q.v.).

P

pack'aged sys'tem (păk'ŭjd sīs'tēm), *n.* 1. A complete record-playing assembly that comes in one box, called "a hi-fi." 2. A dirty word to the hobbyist who uses "components."

phase in-vert'er (fāz ĭn-vŭrt'ŭr), *n.* An electronic circuit that provides two audio voltages in opposite phase, so that one goes positive when the other goes negative; required in any push-pull (q.v.) amplifier.

pho'no-graph (fō'nō-grăf), *n.* A primitive machine for playing records, used in the days before merchants discovered the sales advantages of a "hi-fi" label.

pick'up (pīk'ŭp), *n.* A device, the modern counterpart of the sound-box, that transcribes the undulations of a record groove into electrical waves, for amplification before being converted into sound by the loudspeaker.

pi'e-zo-e-lec'tric (pī-ē'zō-ē-lĕk'trĭk), *adj.* Utilizing substances in which twisting or bending of the material by the stylus motion produces an electrical output.

pitch (pĭch), *n.* The combination of frequency and intensity in a sound, judged by the average musically trained ear, that determines its position on a musical scale.

plat'ter (plăt'tŭr), *n.* Familiar name for a phonograph record, disc type.

port (pawrt), *n.* A carefully dimensioned and positioned hole, used in a bass-reflex (q.v.) enclosure. Also called a vent.

pre-am'pli-fi-er (prĕ-ăm'plĭ-fĭ-ŭr), *n.* Abbr. pre-amp. An amplifier not designed to deliver power output, but to receive the very small inputs from pickups and/or tape heads, provide equalization, tone control, volume and/or loudness control, and produce output sufficient for the input of a basic amplifier (q.v.). Also given the sophisticated name of au'di-o-con'trol' cen'ter.

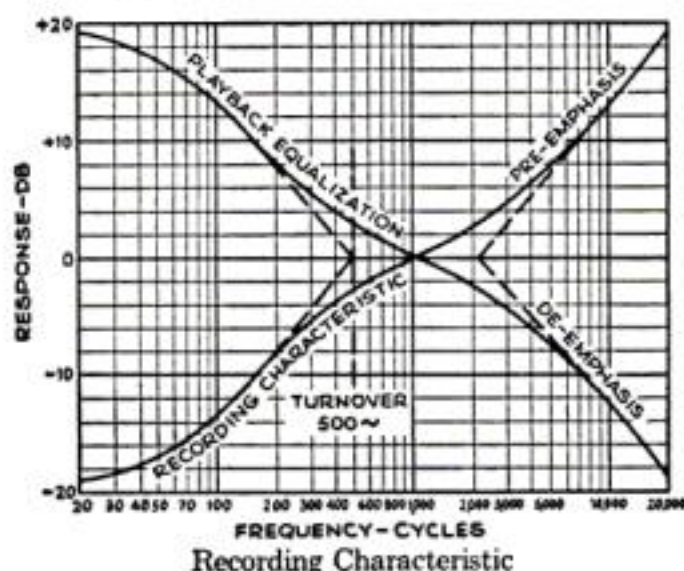
pre-em'pha-sis (prĕ-ĕm'fŭ-sĭs), *n.* A process used, in transmitting F.M. or making records, to increase the relative intensity of higher frequencies for better signal-to-noise ratio (q.v.). (See also de-emphasis.)

pres'ence (prĕz'ĕns), *n.* 1. An impression, due to the degree of realism, that the original program source (e.g. an orchestra) is in the room. 2. An additional slight boost given to frequencies in the range from 3,000 to 5,000 cycles, alleged to enhance the effect.

push-pull (push-pul), *n., adj.* A method of operating tubes and transistors in amplifiers, so that the current in one, due to the audio, increases while the other decreases; and vice versa—the purpose being to improve performance and efficiency of the amplifier's output stage.

R

- ra'ti-o de-tec'tor** (rā'shē-ō dē-tēk'tūr), *n.* One type of detector for extracting the audio from an F.M. transmission (see F.M.).
- rec'ord chang'er** (rēk'awrd chānj'ūr), *n.* 1. A machine designed to play a number of phonograph records automatically. 2. A music-store customer who's dissatisfied with his latest purchase.



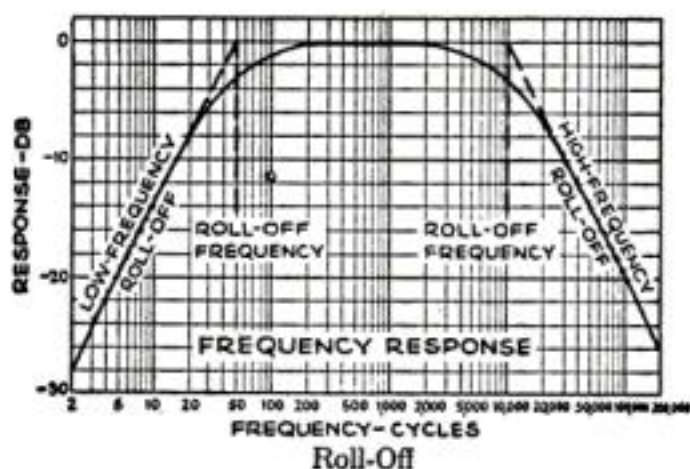
- re-cord'ing char'ac-ter-is'tic** (rū-kawrd'ing kār-āk-tūr-is'tik), *n.* The overall frequency response used for making a record, consisting of de-emphasis below turnover (q.v.) and pre-emphasis (q.v.). (See also equalization.)

- rec'ti-fi'er** (rēk'ti-fī'ūr), *n.* An essential part of the power supply of any system powered by 60-cycle line; it converts AC into the DC required for operating the equipment.

- res'o-nance** (rēz'ō-nāns), *n.* A tendency of mechanical parts, e.g. pickup stylus, tone arm, loudspeaker cone, enclosure panel, to vibrate at one particular frequency, causing undesirable overemphasis of that frequency when it occurs in the program.

- re-ver'ber-a'tion** (rū-ver'ber-ā'shūn), *n.* Reflected sound that follows the original so closely that it is not heard as a separate entity, but seems to reinforce it.

- RIAA curve** (ahr-i-ā-ā kūr), *n.* Short for Recording Industry Association of America curve; the standard recording characteristic (q.v.) in this and most other countries for microgroove records; or the corresponding equalization curve for playback.



- roll-off** (rōll-awf), *n.* 1. A progressive reduction in amplification or reproduction of frequencies, extending either upward or downward from a particular frequency. 2. The frequency at which reduction begins.

- rum'ble** (rūm'būl), *n.* A spurious low-frequency sound caused by vibration of the turntable motor or associated machinery, made audible by being transmitted mechanically to the pickup.

S

- se-lec-tiv'i-ty** (sū-lēc-tiv'i-tē), *n.* A measure of the ability of a radio tuner to separate radio transmissions on adjacent channels.

- sen-si-tiv'i-ty** (sēn-sī-tiv'i-tē), *n.* A measure of the minimum signal a piece of equipment, such as a tuner or pre-amplifier, will satisfactorily handle, from an antenna or pickup.

- sig'nal-to-noise ra'tio** (sīg'nūl-tō-noiz rā'shē-ō), *n.* A measure, in decibels, of the difference between the loudest audio and the background noise of a system or record.

- squawk'er** (skwawk'ūr), *n.* A name preferred in some circles for the mid-range speaker unit of a three-way system.

- stat'ic** (stāt'ik), *n.* 1. Radio interference that causes a sputtery sound, especially that, called man-made static, due to electrical machinery. 2. With modern vinylite-disc records, an electrical surface charge that attracts dust.

- ster'e-o-pho'nic sound** (stēr'ē-ō-fōn'ik sownd), *n.* Sound produced by two or more loudspeakers, each using a recording of the same program made independently from separate microphones, the object being greater realism.

- strob'o-scope** (strōb'ō-skōp), *n.* A disc with uniform radial black and white markings to be applied to turntables for checking speed. When viewed under alternating-current light of the correct frequency (usually 60 c/s) the pattern appears to stand still when rotation is at the correct speed.

- sty'lus** (stī'lūs), *n.* 1. The modern counterpart of the old phonograph needle, consisting of a sapphire or (preferably) diamond tip precisely shaped to conform to the groove contour, persistently called *needle* by the uninitiated. 2. The needle in a \$20 phonograph, if you want to talk hi-fi.

- sty'lus force** (-fawrs), *n.* The downward force exerted on the stylus to keep it in the groove.

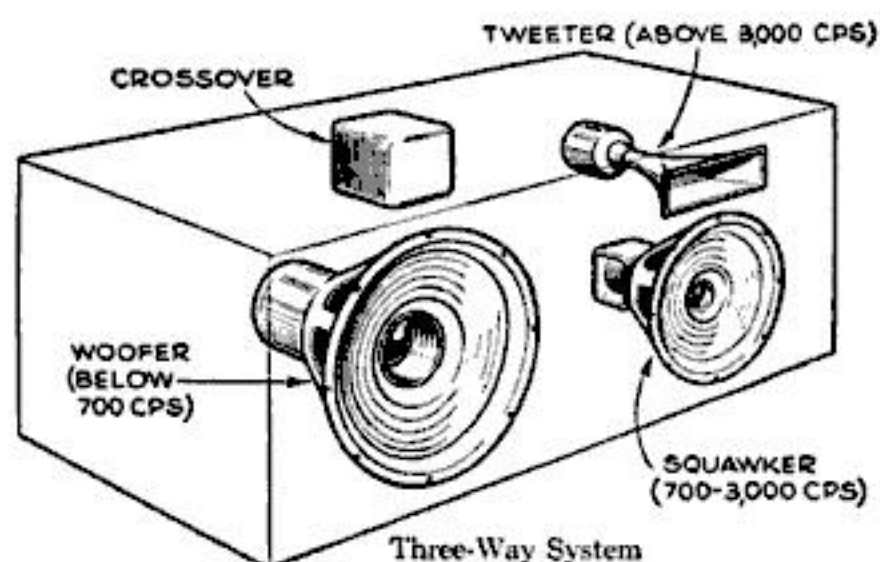
- sur'face noise** (sūr'fis noiz), *n.* A form of unwanted sound, due to irregularity in the groove surface of a disc; or, in a tape, to irregularity in the magnetic material.

- sur-round'** (sūr-rownd'), *n.* The part of a loudspeaker cone by which its outside edge is anchored, usually corrugated.

T

- tape re-cord'er** (tāp rū-kawrd'ūr), *n.* A machine for making records on magnetic tape and usually also for playing them back.

- throat** (thrōt), *n.* The narrow part of a horn next to the loudspeaker diaphragm or cone.



three-way sys'tem (thrē-wā sīs'tūm), *n.* A loudspeaker system using three units: a woofer to handle the lowest frequencies, a mid-range unit (squawker) for the mid-frequencies, and a tweeter for the high frequencies.

tone arm (tōn arm), *n.* Originally the tube used to convey the sound (or tone) from the sound box to the horn of the phonograph; whence, in modern systems, the arm that holds the pickup cartridge and ensures that the stylus is correctly aligned with the groove.

tone con-trol' (-kūn-trōl'), *n.* One or two controls for adjusting the balance of frequencies in the program to the listener's taste.

trac'ing dis-tor'tion (trās'ing dīs-tawr'shun), *n.* A form of distortion in record playback due to the difference in shape between the recording and reproducing styli.

track'ing er'ror (trāk'ing er'rūr), *n.* Deviation from the ideal in the alignment of the stylus with the groove—inherent in the use of a pivoted tone arm; the angular measurement between the axis of the pickup and a line tangent to the groove being played.

trans-duc'er (trāns-dōōs'ūr), *n.* Any device for converting energy from one form to another—acoustic, mechanical or electrical; hence a general name including pickups, recording heads, microphones, loudspeakers, etc.

tran'sient (trān'shēnt), *n. adj.* 1. (mus.) The initial part of any tone played by an instrument or instruments. 2. (audio) Any abrupt or nonrepetitive waveform.

tran'sient dis-tor'tion: *n.* 1. Failure to amplify any transient correctly. 2. A name often given to any unaccountable sound in the reproduction.

tran-sis'tor (trān-zīs'tūr), *n.* A modern refinement of the crystal and cat-whisker that produces amplification, and, for some applications, can supersede tubes.

tre'ble (trē'būl), *n.* 1. Musical tones corresponding with a rate of vibration greater than 260 per second (played in the treble clef). 2. Audio in the range of frequency delivered by the crossover to the tweeter of a two-way system. 3. Unspecified higher frequencies.

tube (tōōb), *n.* An envelope, usually of glass, evacuated to enable free passage of electrons, and containing essentially: a heated cathode to emit electrons, one or more grids to control their flow, and a plate to receive them. Sometimes two or more assemblies are contained in one envelope; in these cases the word tube may be applied either to each assembly or to the entire envelope.

tun'er (tōōn'ūr), *n.* A special radio receiver, giving an output suitable for feeding to a basic amplifier, not to a loudspeaker.

turn'o-ver (tūrn'ō-vūr), *n.* In making records, the frequency below which a progressive reduction in level is applied to achieve a particular recording characteristic (q.v.); in playback, the point at which the corresponding boost takes place (at 500 c/s in the RIAA curve).

turn'ta-ble (tūrn'tā-būl), *n.* The revolving table on which a disc record is placed for playing.

tweet'er (twēt'ūr), *n.* The loudspeaker unit that handles the highest frequencies.

U

u'ni-ta'ry (yū'nī-tē'rē), *adj.* Applied to types of loudspeaker in which two or more loudspeaker units are built into a single assembly, as in coaxial construction.

V

valve (vāl-v), *n.* Same as tube (Br.).

va'ri-a-ble damp'ing (va'rē-ū-būl dāmp'ing), *n.* An adjustable feature in a basic amplifier that makes it possible to vary the output impedance to the loudspeaker, thus changing its damping factor (q.v.).

vent (vēnt), *n.* See port.

vi'nyl-ite (vī'nīl-īt), *n.* The material of which modern microgroove records are pressed, molded or fused; hence, a familiar name for these discs, which are also known as vinylite biscuits.

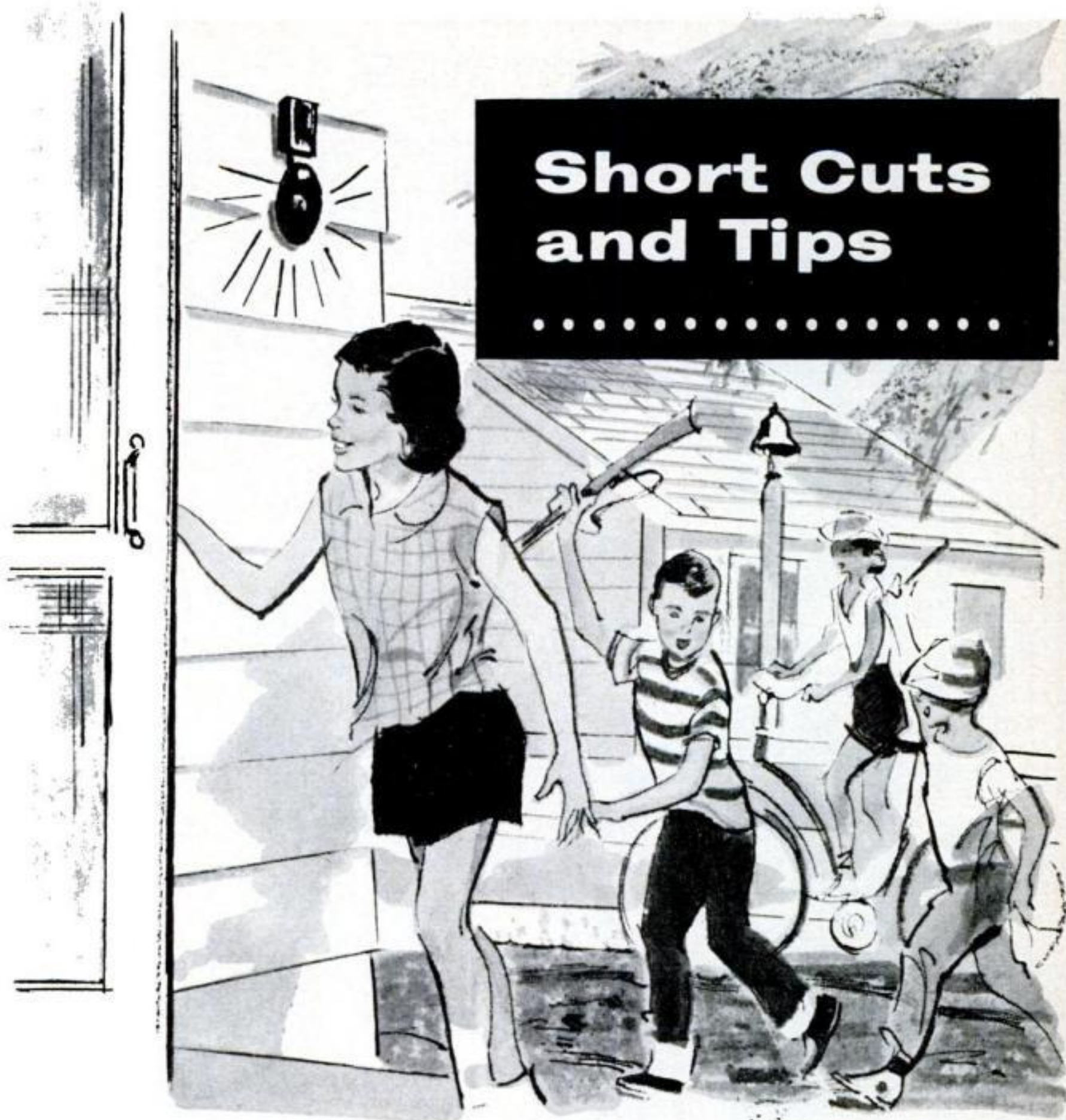
voice coil (vois kōil), *n.* The delicate coil in a loudspeaker unit, through which audio current flows to produce the force on the cone or diaphragm that in turn produces the sound.

vol'ume con-trol' (vōl'yūm kūn-trōl'), *n.* A gain control (q.v.) intended for adjustment of volume of sound, but without loudness compensation (see loudness control).

W

woof'er (woof'ūr), *n.* A loudspeaker unit built specifically to handle the lowest audio frequencies.

wow (wow), *n.* 1. A slow (about twice-per-second) fluctuation in the speed of a turntable, or the equivalent in tape drive, that causes a corresponding fluctuating pitch in program reproduction. 2. The effect it has on reproduction.



Short Cuts and Tips

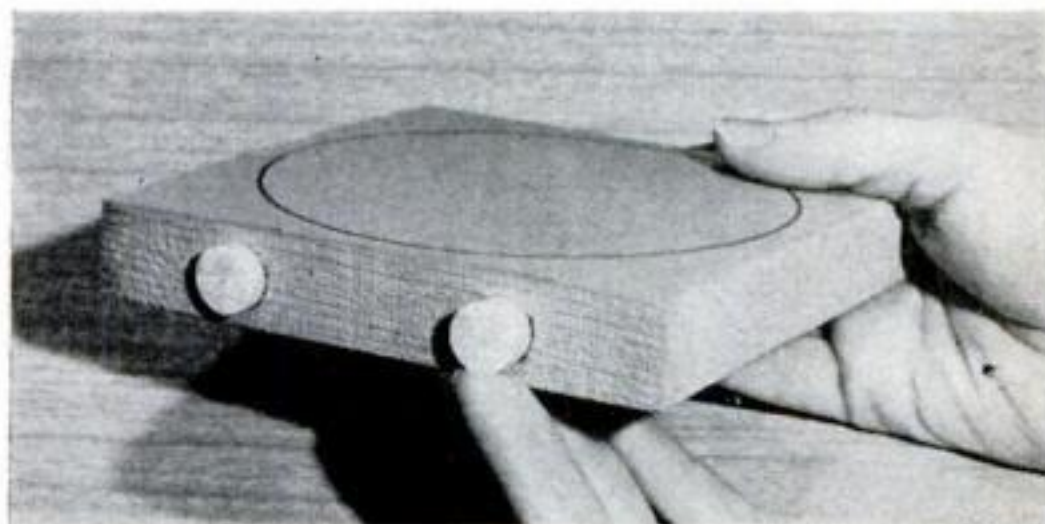
Why Yell? This Kid-Calling System Rings the Bell

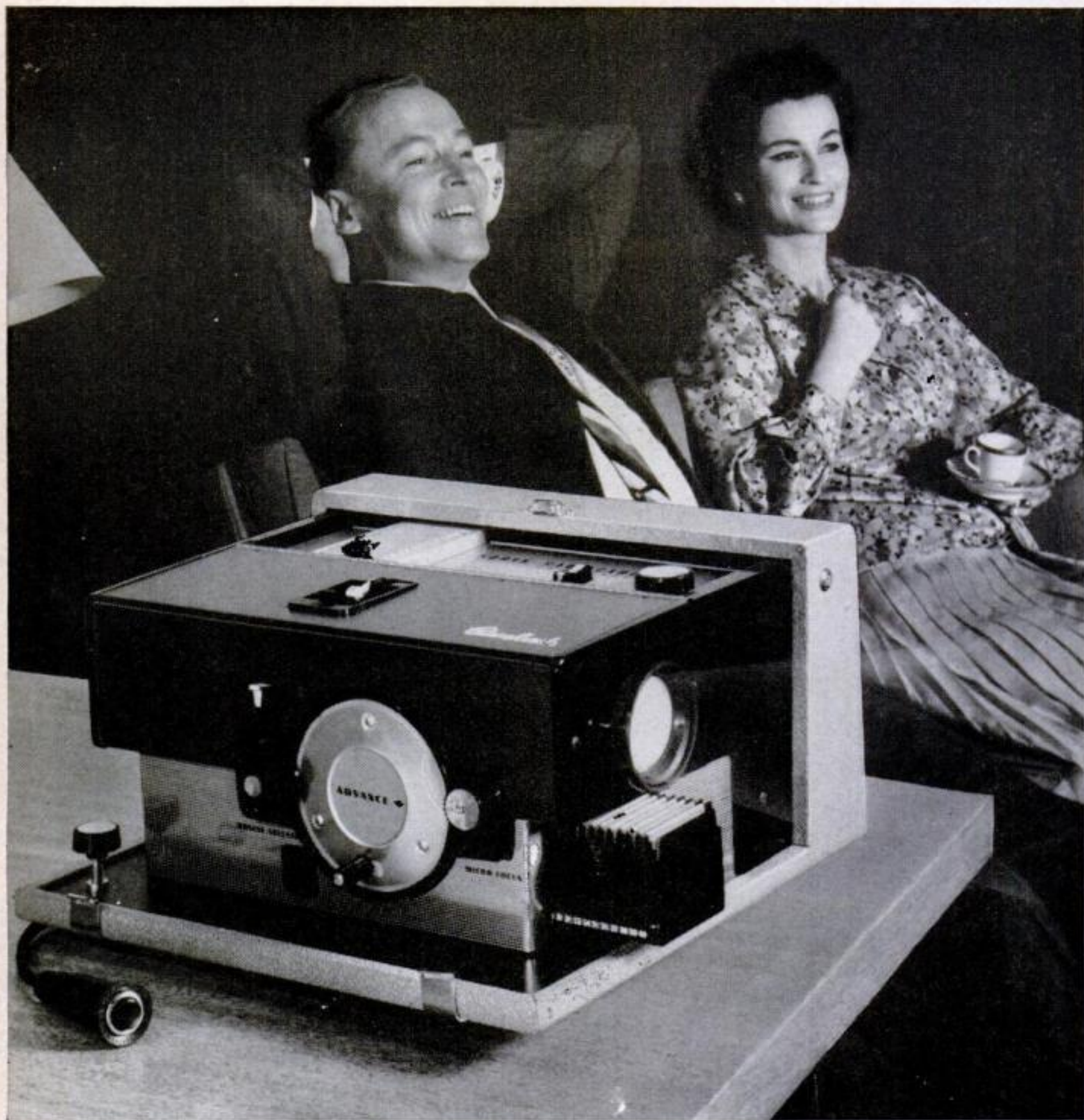
OUR neighborhood has solved the problem of calling our children. Each household has a bell—one a coach bell, one a large bell mounted on a post, and several have hand bells. My family uses an elec-

tric bell, mounted outside with a button in the kitchen. Each child has an individual call of a certain number of rings. Six rings means "everybody come."—*Richard Callaway, Maryville, Tenn.*

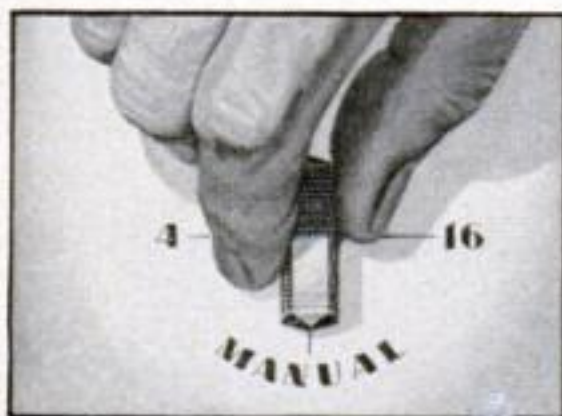
How to Avoid Splits in Wood Wheels for Toys

WILL the wooden wheels you make for junior's car split across the grain? They won't if, before you saw them out, you glue two or more dowels, as reinforcement, into holes drilled through the blanks across the grain.—*Frank A. Javor, Newark, N. J.*

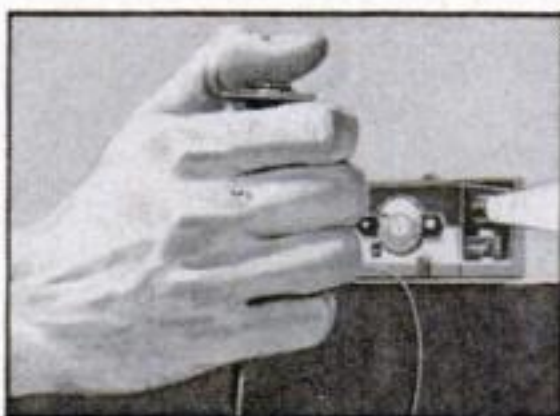




You turn it on . . . it does the rest



Fully automatic timer shows slides at pre-set intervals—4, 8, or 16 seconds. Split-second changes at any speed.



Remote-control changing up to 12 feet from projector—control show as you sit with guests. Cord included.



Semi-automatic changing—turn wheel to show slides in backward or forward order. Reverse order at any time.

EASTMAN KODAK COMPANY,

New Kodak Cavalcade Projector changes slides by itself!

You turn it on . . . it does the rest!

IMAGINE! A color slide projector that lets you relax and enjoy the show without touching a button . . . that will project your slides perfectly even if you leave the room.

The new Kodak Cavalcade Projector combines *all* the features you have ever wanted for the *easiest, smoothest* slide shows ever!

For automatic operation, you simply set the timer for the interval you want. Turn on, focus the first slide, and your Cavalcade Projector does the rest.

There are 3 ways to enjoy semi-automatic changing, too. For remote control, a remote cord is included. By push-button, at rear of the projector. Or you can use the control wheel at the side.

Your slides stay in constant focus, because all slides are preconditioned with a stream of air before projection. Never any focus-shift no matter how many slides you show!

The Cavalcade is the only projector that lets you "edit" your slides *while they're in the projector!* You can remove one slide, replace it with another without removing the slide

tray. There's a built-in screen pointer, too.

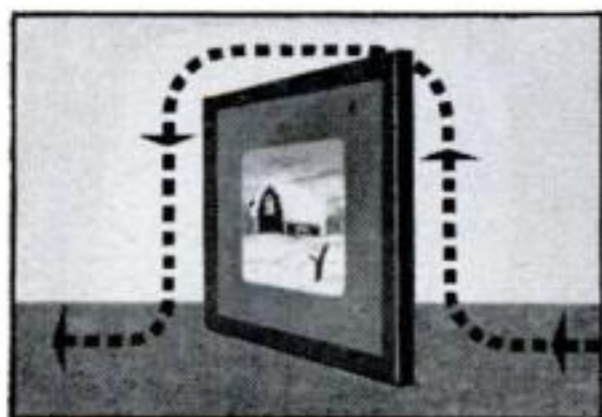
When you place the slide tray into the projector, you insert it *right side up*. Your slides can't spill out.

Choice of slide trays: (1) Takes 40 cardboard slides. (2) Takes 30 glass, metal, plastic slides. U-shaped steel guards protect all slides.

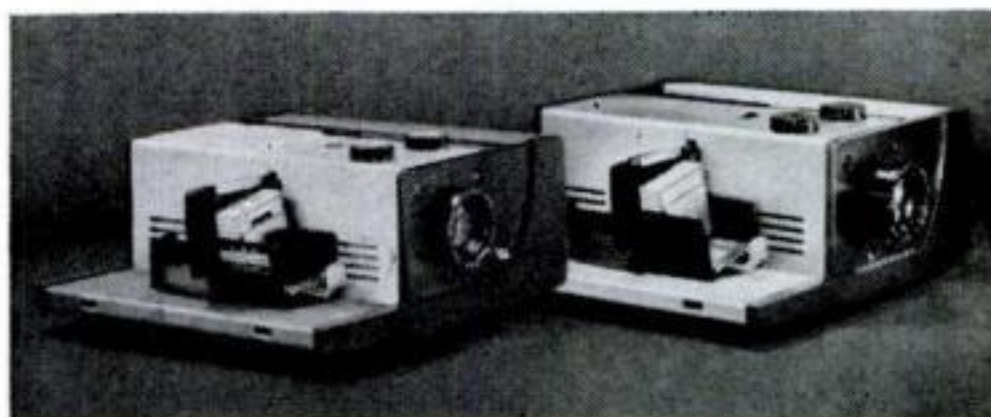
A hi-lo switch on the Cavalcade Projector lets you project with *either* 300 or 500 watts, according to your needs. For "super slides" a supplementary condenser is available for extra-bright showings.

The Cavalcade Projector has an $f/2.8$ lens and a built-in preview screen. Ask your photo dealer to demonstrate the compact new Cavalcade Projector. It has been precision-designed by Kodak to deliver years of wonderful color slide enjoyment.

Price, including 12-foot remote control cord, \$149.50, or \$14.95 down. Price is list, includes Federal Tax, and is subject to change without notice.



Constant focus — No "pop." A special stream of air preconditions every slide—prevents focus-shift during show.



New Kodak 500 Projector is as easy to carry as a portable radio, shows color slides big and bright. Kodak 500 Projector, \$74.50. Also —Kodak 300 Projector, \$64.50.



Kodak
TRADE MARK

Rochester 4, N. Y.

Short Cuts and Tips

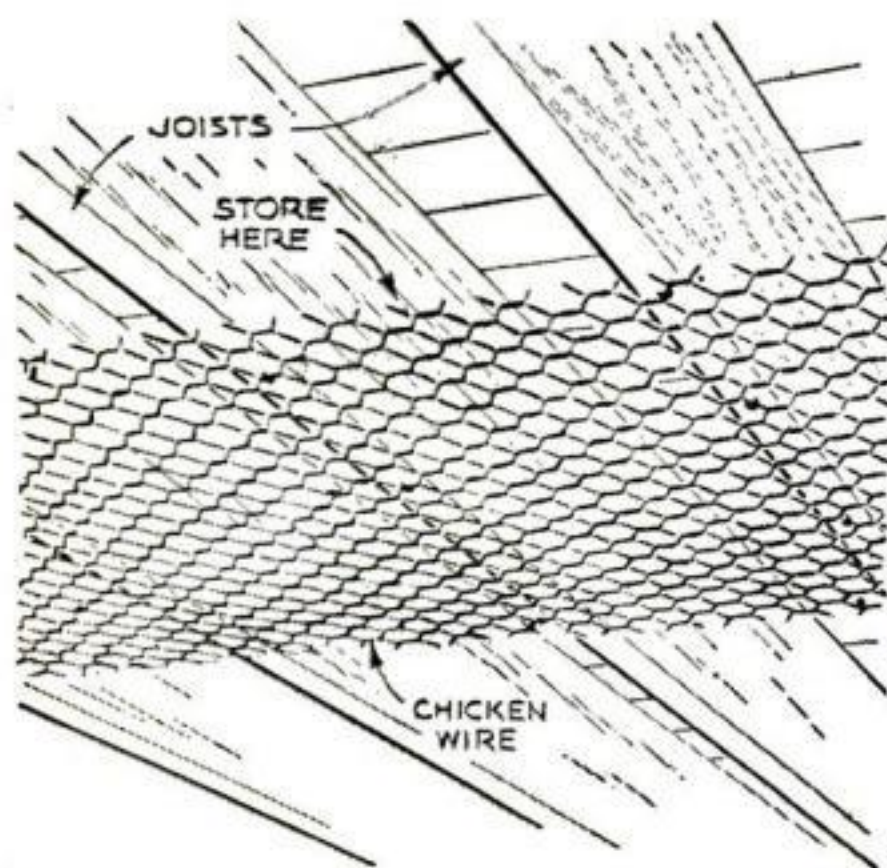
Charcoal Lighter for Your Barbecue

HERE'S how I get a fire going fast for a barbecue. I start the charcoal burning in an old gallon can punched through at sides and bottom with a beer-can opener. On the bottom of the can I lay a small wad of newspaper. Over this goes a layer of light kindling topped with a dozen or so pieces of charcoal.

Then I light the paper through the holes in the bottom. Once the kindling catches fire, I pile on more charcoal and hang the can from the children's swing support with a long rope. It sways gently

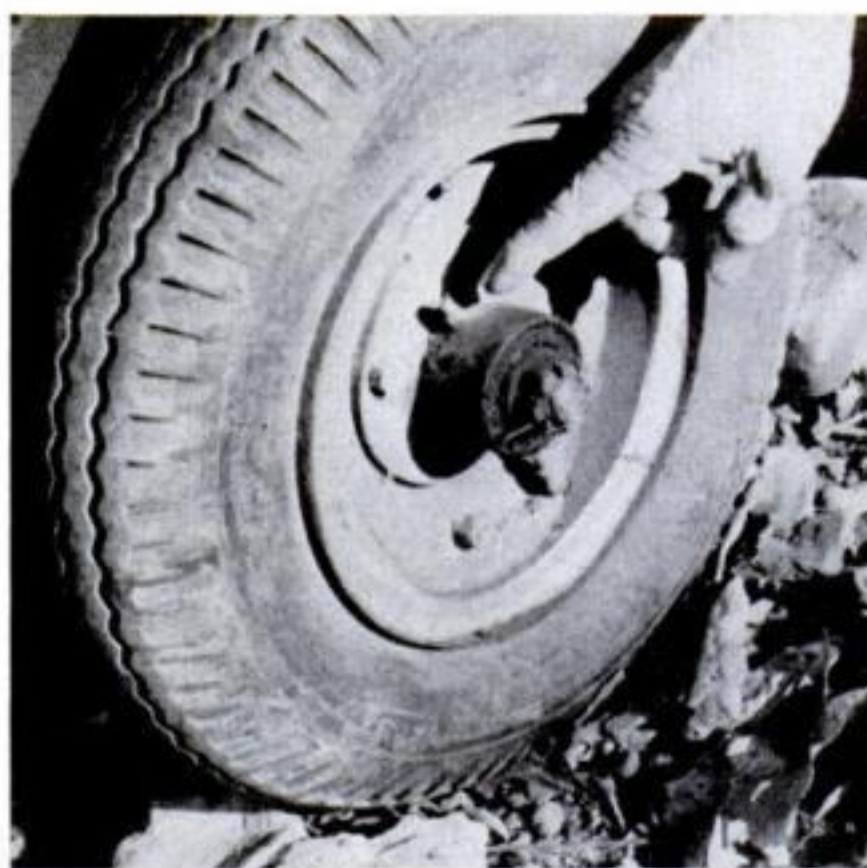


without attention, its contents fanned by air entering the perforated sides. In 15 minutes, the canned fire is burning well enough to be dumped into the brazier.—*J. H. Smith, Williston Park, Ill.*



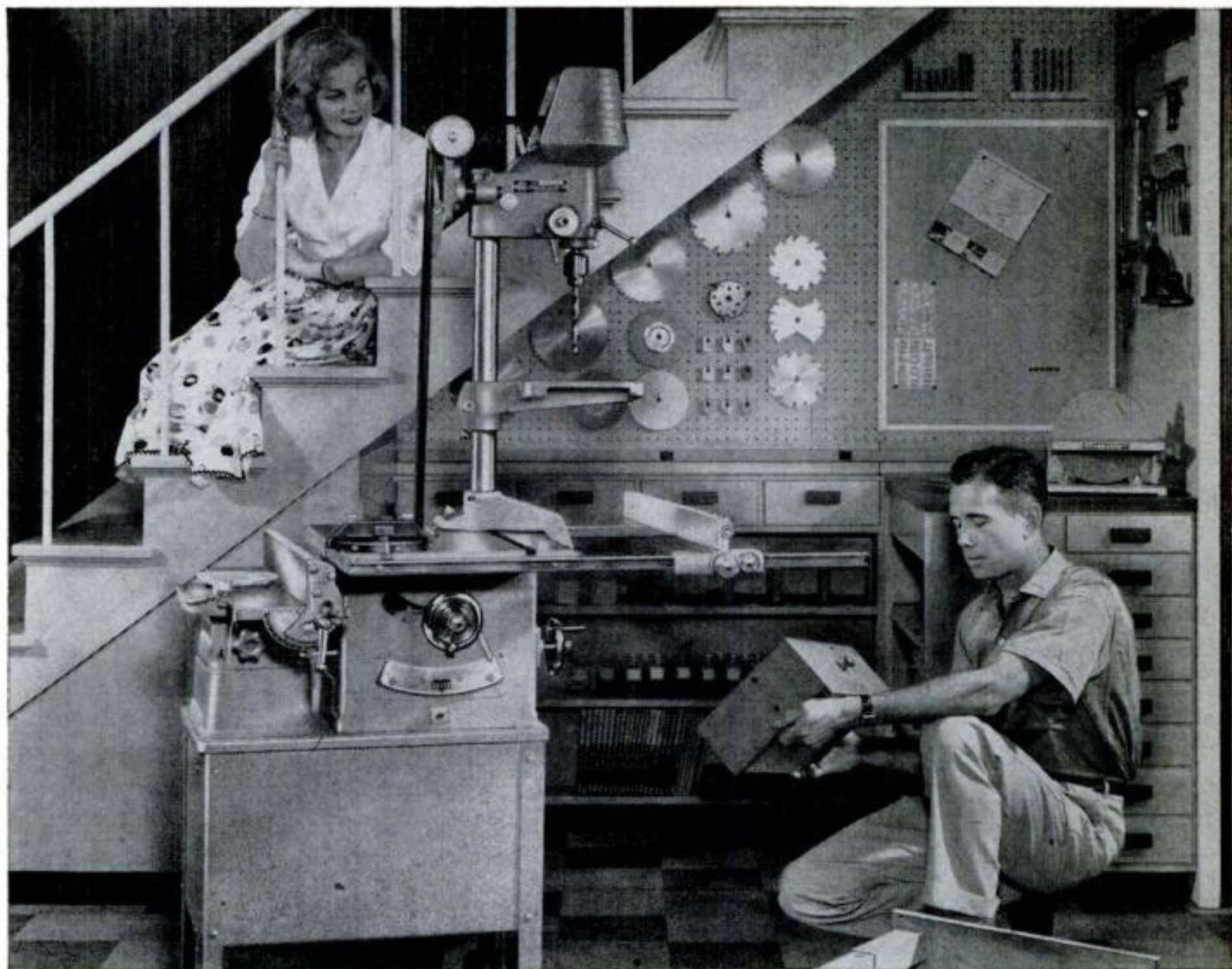
Storage Idea for the Cellar

FOR inexpensive and effective storage in an unfinished basement, take a length of 1"-mesh chicken wire about 2' wide and staple it across the ceiling joists. Place it far enough from the wall or other obstructions to permit access from either side. If cans and bottles are stored with the labels downward, you can read them without removing them from the wire shelf.—*H. E. Lofgren, Sussex, Wis.*



Fitting Eases Grease Job

ONE skipper I know has installed pressure grease fittings in the wheels of his boat trailer to make sure the bearings will always have grease. There's no need to pull the wheels to repack the bearings. After each trip, he simply gives each wheel a couple of shots. This is good maintenance for wheels that go into the water when the boat is launched or loaded.—*L. H. Schrimpf, Tulsa, Okla.*



BIG IDEA FOR SMALL SPACE

***New Advanced Design* DELTA'SHOP**

Combination of 4 full size tools does 95% of all workshop jobs—yet takes space only 3 feet square!

If you want a *real* shop, but don't have a lot of space, the DELTASHOP is for *you*. It's the most *practical* all-purpose combination tool built!

Here's why: In a space just 3 feet square it puts at your finger tips a powerful 9" tilting arbor circular saw, a 4" jointer, an 11" drill press, and an 8½" disk sander—all mounted on one stand and powered by one motor. And because Delta-Shop is a combination of *full size* tools (not attachments) you can buy it all at once (as little as 10% down), or the easy Tool-At-A-Time way.

IT'S SO EASY TO OWN THE BEST!

Because Delta makes the world's most *complete* line of combination, all-purpose and individual power tools, you can choose tools exactly right for *you*. And you'll have the "newest look" in the world's finest power tools.

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Delta experts designed this shop so that you can build it. Easy-to-follow plans and the New Delta Reference Guide are yours—**FREE**—just send a post card with your name and address to: Delta Power Tool Division, Rockwell Mfg. Co., 504E N. Lexington Ave., Pittsburgh 8, Pa.

Do it now—then see all the New Advanced Design Delta Tools at your Delta Dealer. (He's listed under "TOOLS" in the Yellow Pages.) Or at leading Department, Hardware, and Building Supply Stores.

DELTA POWER TOOLS

another fine product by

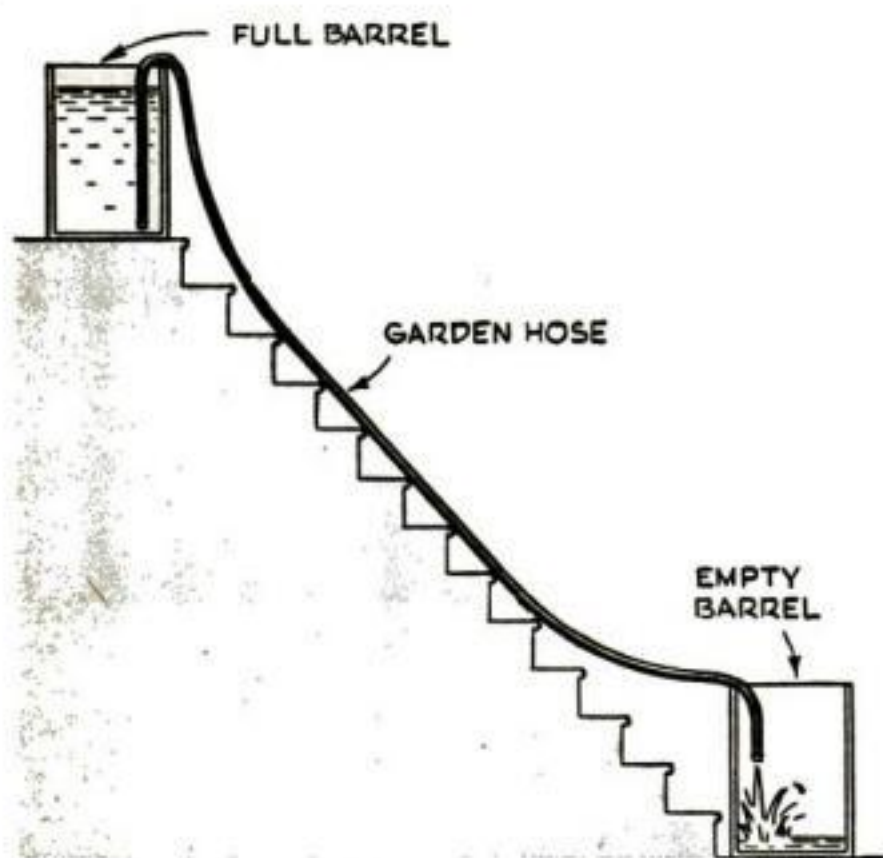
ROCKWELL



Short Cuts and Tips

Milk Cartons Used for Seedlings

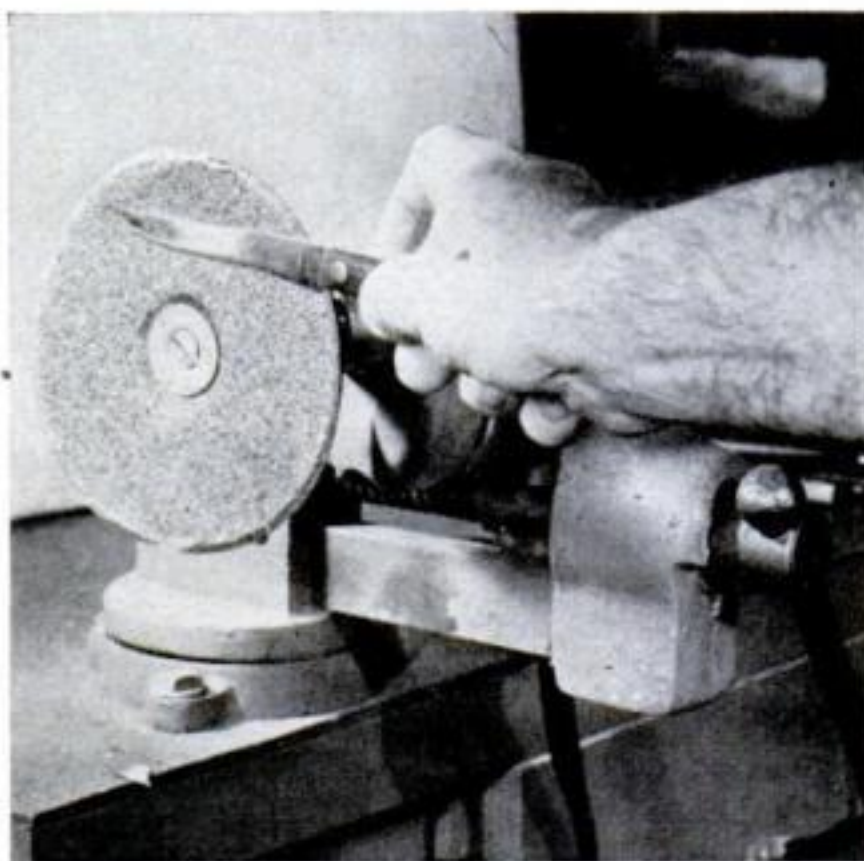
WAXED milk cartons make handy temporary boxes for carrying seedlings. Close up the pouring spout and cut out one side. For a reasonable length of time, the containers will hold moistened dirt containing the seedlings. I find the two-quart and gallon sizes most convenient to use.—*R. M. Woodbury, Natick, Mass.*



How I Flowed Oil Downstairs

How could I move a 50-gallon drum of oil—too heavy for one man to handle—down a cellar stairway? My solution: Siphon the oil into an empty barrel placed at the foot of the stairs.

I filled a length of $\frac{5}{8}$ " plastic garden hose (rubber would deteriorate) with some oil still on hand, stopping one end with a nozzle. The nozzle end of the hose went into the empty barrel, the open end into the full one. Then I opened the nozzle and oil gravitated from one barrel to the other. Water and other liquids can be moved to a lower level in the same way.—*Warren M. Smith, Holyoke, Mass.*



Sharpening Knives at Home

To SHARPEN kitchen knives, place an electric drill in a vise and fasten a worn-out abrasive disk on your backing pad. Light pressure is all that is needed to sharpen the knives. Use caution never to draw any color on the cutting edge.—*D. A. Rogers, Minneapolis, Minn.*

▶▶▶ When you have to measure long lengths of wire, pipe, wood, rope, or even boards, you can do it quickly if you have a big ruler painted on the workshop floor. Mark off the space in feet where you have the longest open floor space.—*John Mihalick, East Liverpool, Ohio.*

*These men planned
their service—
so can you!*



Pfc. Frank J. J. Kirchner, Jr.
Annapolis, Maryland
Graduate,
Annapolis High School

"I found only the Army would give me just the schooling I was looking for. Under its technical training program for high school graduates, there are so many different varieties of courses, there's one for everybody. I chose Supply Management, and the course was even better than I thought. You can pick your training, too."

Pvt. James Weikert
Dubois, Indiana
Graduate,
Dubois High School



"I don't know where you could find a better Construction Surveying course than the one I took under the Army's technical training program. What's more, only the Army guarantees you the course you want *before* you enlist. That was really important to me because I knew just where I was going when I enlisted. I'd sure advise you to find out about this great training opportunity."

Seniors—get all the details on how high school graduates can choose their technical training before enlistment from 127 modern courses. Mail this coupon for your free booklet today. Or for immediate counseling visit your local Army Recruiter. He's listed in the phone book and will give you all the facts—at no obligation!

THE ADJUTANT GENERAL PS-5-58
Department of the Army
Washington 25, D. C.
Attn: AGSN

Please send me the free Army booklet telling how high school graduates can choose their technical training before enlistment in Modern Army Green.

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*Get your Choice
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**Only in
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ARMY
GREEN**

**can you
choose
from 127
Training Courses**



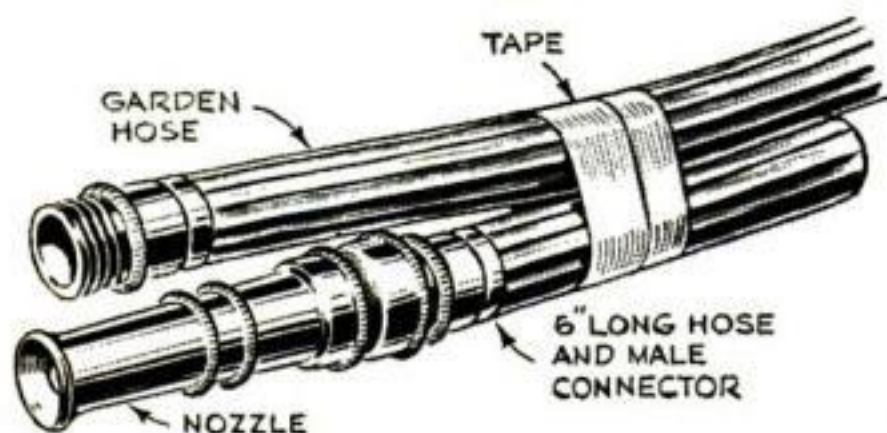
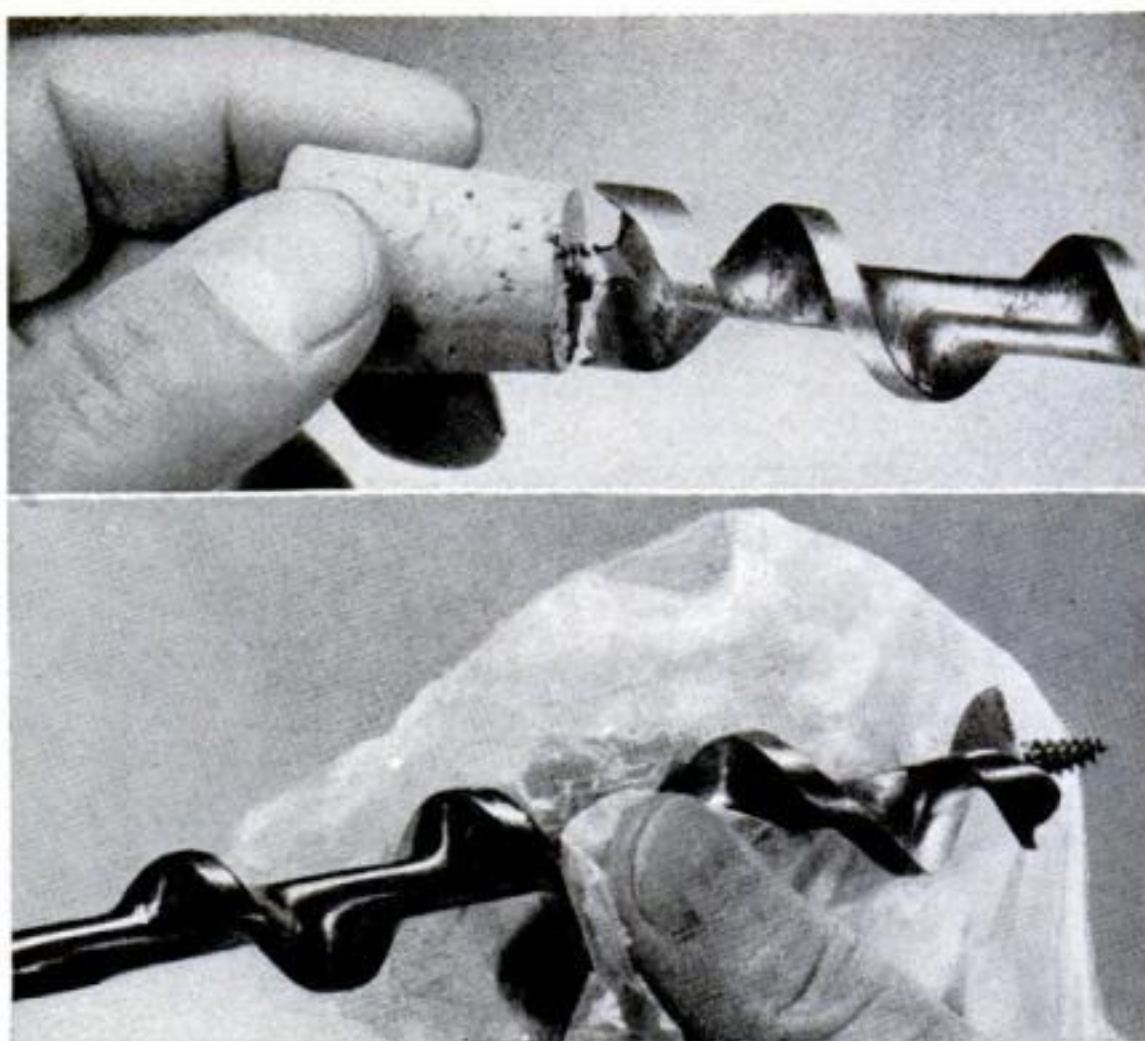
Get Choice, not Chance,
in
MODERN ARMY GREEN



Short Cuts and Tips

Two Good Points About Wood Bits

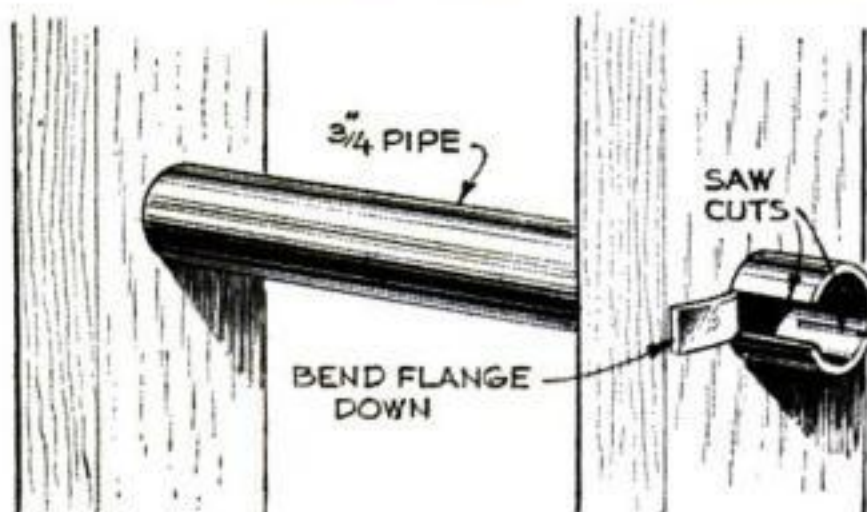
HERE'S before-and-after treatment that's easy to apply. A cork screwed on a wood bit will protect it when it's carried in a tool kit. Then, after you use a bit, wipe it thoroughly with a piece of wax paper. The trace of paraffin left on the bit will seal out moisture and prevent rusting.



Now You Won't Lose the Nozzle

GOT an old garden hose kicking around? Or an extra hose coupling? Cut off about 6" of the nozzle end of the hose, or attach the male part of the coupling to a piece of hose, and tape it to the end of your good hose like this.

Then you'll always have a place to store the nozzle when you remove it to use the hose for jobs needing lower pressure.
—W. B. Eagan, *Floyds Knobs, Ind.*



Rung Formed from Pipe

I USED a piece of $\frac{3}{4}$ " pipe to replace a broken rung in my extension ladder. After drilling the stubs from the sides of the ladder, I cut the pipe so it would project slightly on either side. Then I cut saw slots in the ends of the pipe, put the pipe through the ladder, and hammered down the ends to form tight-holding flanges against the sides of the ladder.

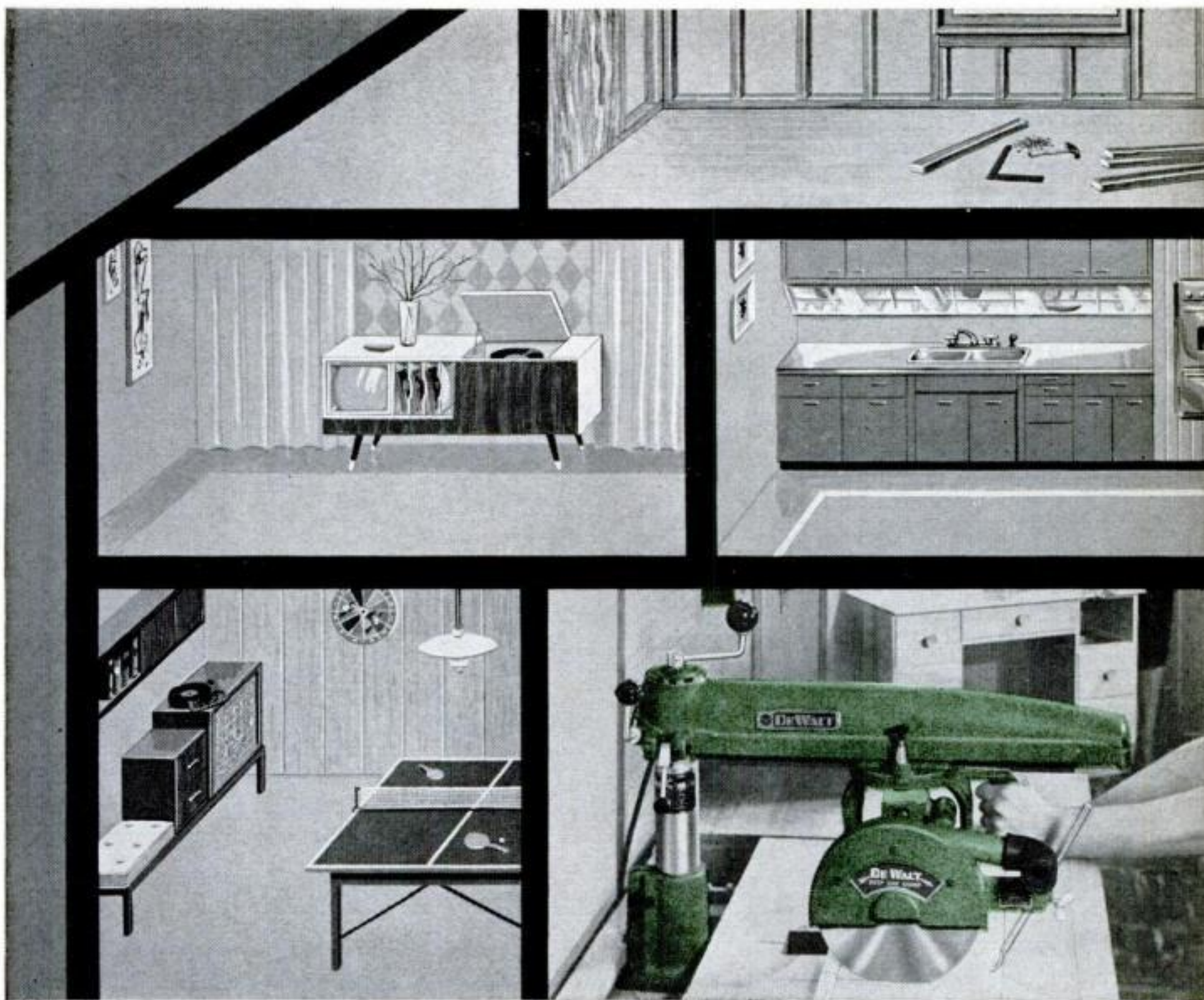
—Frank Jefferies, *Bloomfield, N. J.*



Here, Now, Is a Jack-of-All-Stools

THIS old piano stool is leading a busy new life after a face-lift rescued it from the attic. The people who own it have used it as a serving table in the kitchen, a plant stand in the living room, a snack table by the TV set—even as a piano stool.

The refurbishing included a new gray enamel applied over a bleedproof undercoater, shining up the brass claws and resurfacing the cracked and battered old swivel top with Marlite in a black-and-gold marble pattern.



The De Walt Power Shop can make you AN EXPERT WOODWORKER—

This one power tool makes it easy—even for beginners—to build anything!

Like to turn the attic into a playroom... panel and furnish a room for "Johnny"? How about a hi-fi cabinet? A bookcase... tennis table... a boat... kitchen cabinets? With a De Walt® Power Shop you can make your home fit every family need. And save money, too!

De Walt is the original radial arm saw... the complete home workshop in one machine that has revolutionized woodworking, made it safe and easy for everyone! Even if you've never used power tools before you can do professional work from the beginning.

With the De Walt Power Shop you always see exactly what you're doing... follow layout marks with ease... never spoil expensive lumber. Right from the start you're protected by De Walt's exclusive safety features. What's more, your De Walt Power Shop takes no more room than the average home appliance! And you can own a De Walt Power Shop for as little as \$2.50 a week!

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at your nearby De Walt
Dealer today!**

SEND COUPON FOR VALUABLE PLANS

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De Walt, Dept. PS-805, Lancaster, Pa.
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- ☐ Please send valuable Free Home Workbench Plans.
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Short Cuts and Tips

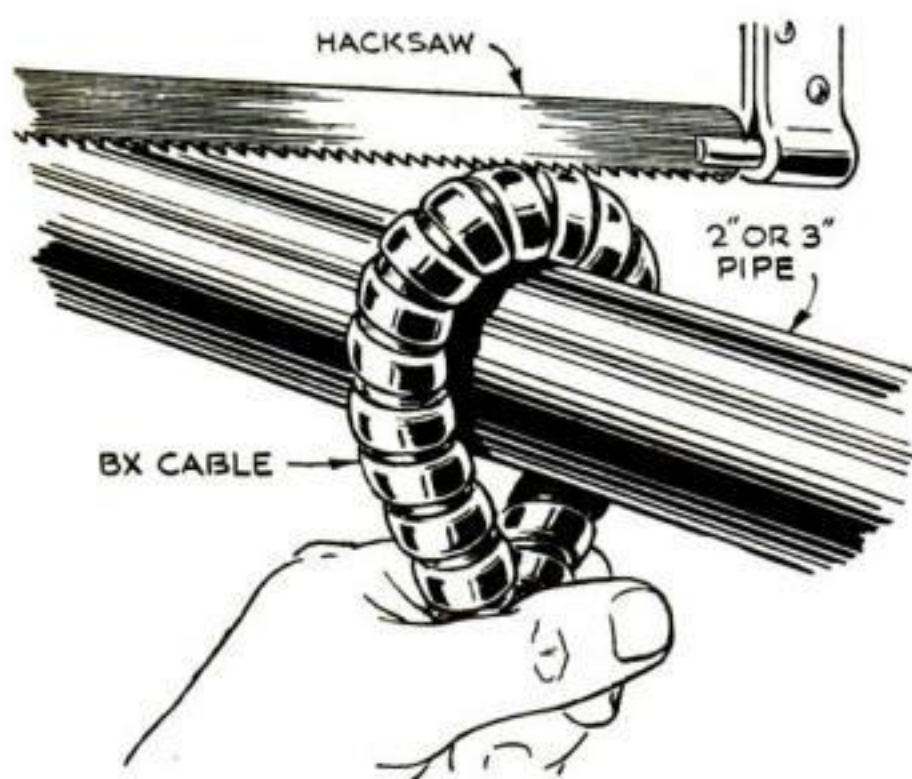
Bar Is Tool-Box Handle

A WRECKING or pinch bar is usually too awkward to fit inside a tool box, so it often gets misplaced. Used as the handle for a tool tray, however, a bar is right within hand's reach when you need it.—

George L. Housely, Pocatello, Idaho.

▶▶▶To KEEP wooden door or drawer knobs from working loose, turn the fastening screw up tight from the inside, then drive a brad through into the knob, also from the inside. The knob can't turn now. But if you ever want to remove it, you can do so by turning out the screw, and then pulling the knob off the nail.—

Neal Singletary Jr., Ponca City, Okla.

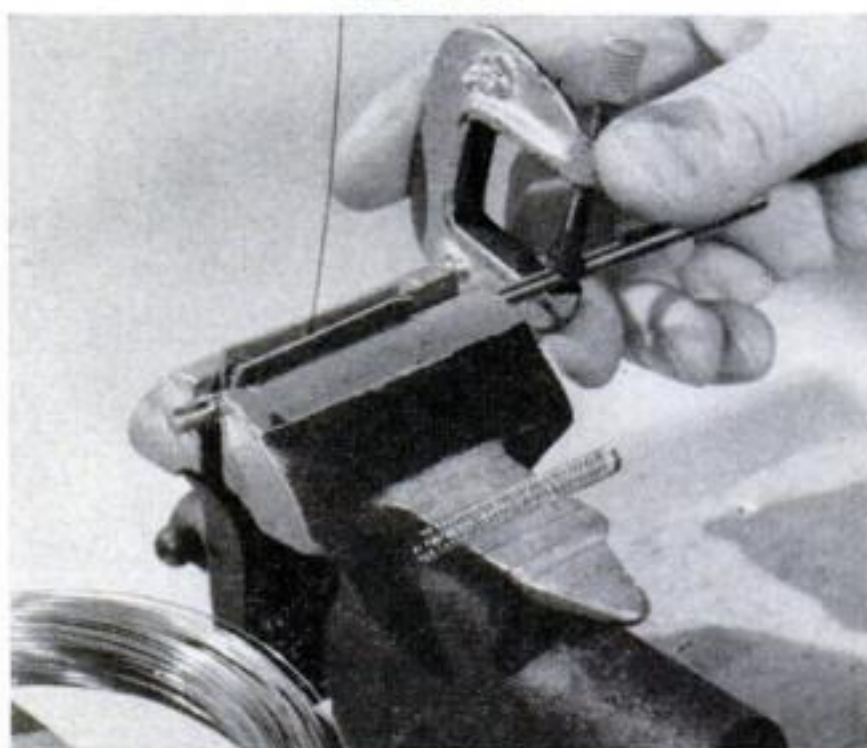


Easier Way to Hacksaw BX

ARMORED electric cable can be cut more easily if you first wrap it around a piece of 2" or 3" pipe and grasp the two ends underneath with one hand while you saw diagonally across the looped cable on top.—

John Mitchell, Cincinnati.

▶▶▶WHEN you need to match a natural finish that has colored with age, you can nearly always do it with orange shellac. Control the depth of color by thinning the shellac as required with alcohol.



How to Wind Coil Springs

It's a simple job to wind small coil springs if you use a piece of leather and a vise. Use a metal rod as a mandrel, slotting or drilling one end for starting the wire. Lay the mandrel in the folded leather and secure it in the vise jaws. As the mandrel is turned, the wire will form threads inside the leather, keeping each turn against the adjoining one. To make open compression springs, feed the wire into the folded leather at an angle.—

Ken Murray, Colon, Mich.

Announcing: nearly 100° of extra protection with new *MoPar* "Hi-Temp" Brake Fluid



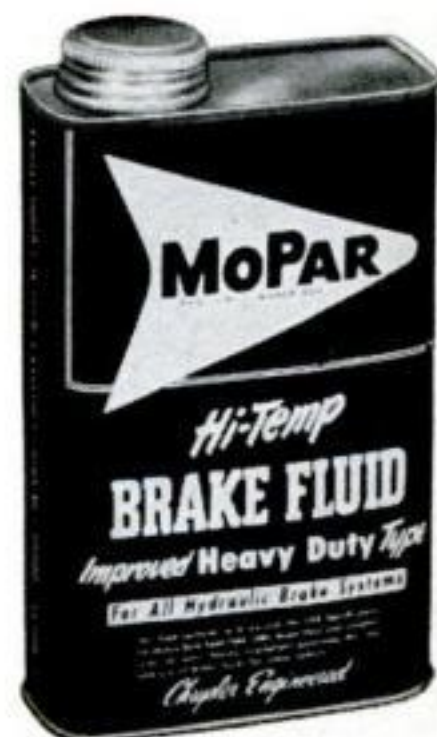
EXTRA SAFETY

Five years of grueling road tests, over mountain roads, in desert heat and in city traffic... five years of continuous research in Chrysler laboratories... these stand behind this news announcement of major importance.

Today's new MoPar "Hi-Temp" Heavy-Duty Brake Fluid stands up to heat nearly 100° higher than present specifications established by the Society of Automotive Engineers.

This "difference in degree" can make all the difference in safety, because the friction heat of braking can raise brake fluid to the boiling point—and bubbles in the lines can cause brake fading and failure. MoPar "Hi-Temp" means many extra degrees of assurance.

Next time, make sure you get this entirely new kind of brake fluid. Available at your Plymouth, Dodge, De Soto, Chrysler or Imperial dealer—or at leading independent repair shops.



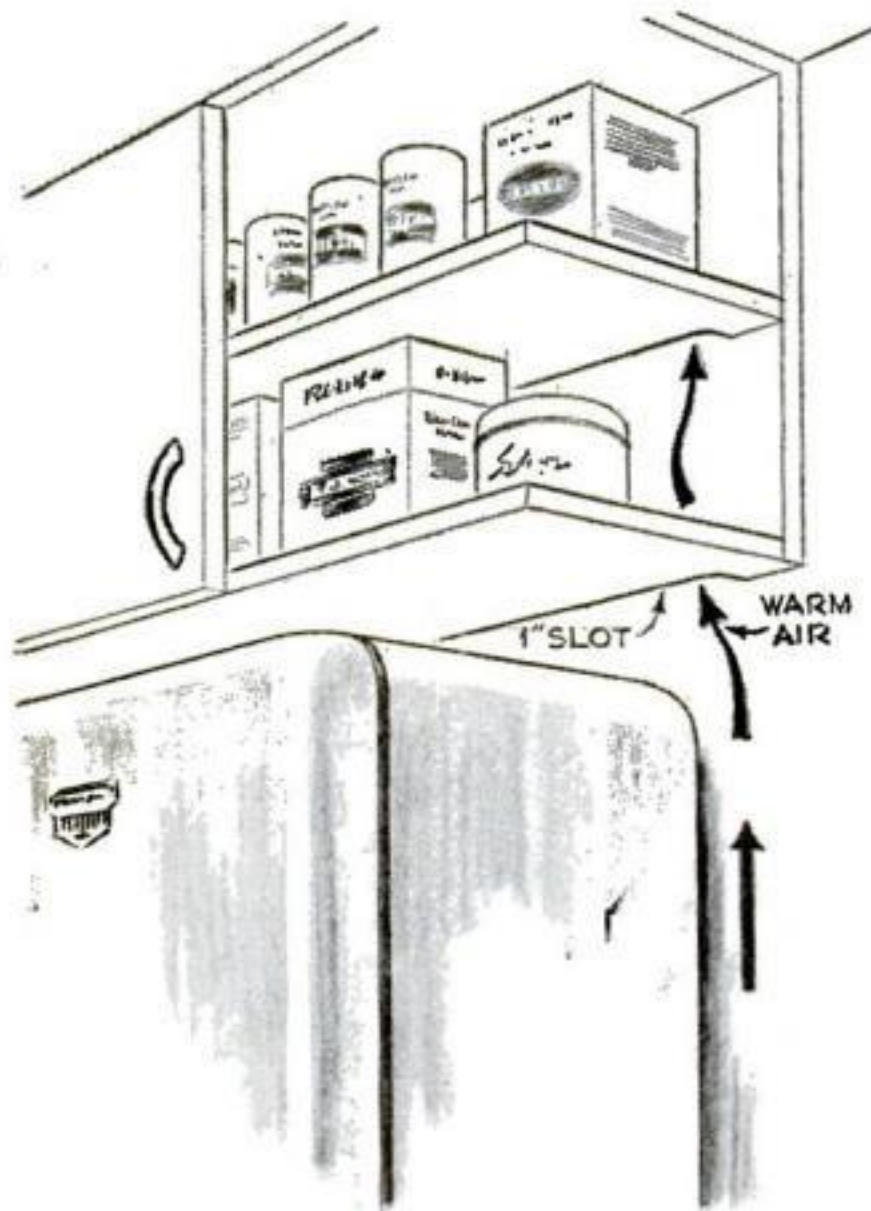
MoPar
PARTS & ACCESSORIES

MoPar Division, Chrysler Motors Corporation
Detroit 31, Michigan

Short Cuts and Tips

Curly snapshots? Roll them flat

PHOTOS that dry with an annoying curl can be made to lie flat by running them through a typewriter against the curl. Drawing them across the edge of a table or desk, the usual method, can cause noticeable cracks in the surface of the prints.—*Eugene M. Hanson, Los Angeles.*



Refrigerator Doubles as Dryer

IF CRACKERS get soggy and salt won't pour, keep them dry the way we do. I cut a slot (you can drill holes instead) in the bottom and next-highest shelf of a wall cabinet above the refrigerator. Warm air rises from the back of the refrigerator into the cabinet, drying its contents.—*William Duggan, Fairfield, Conn.*

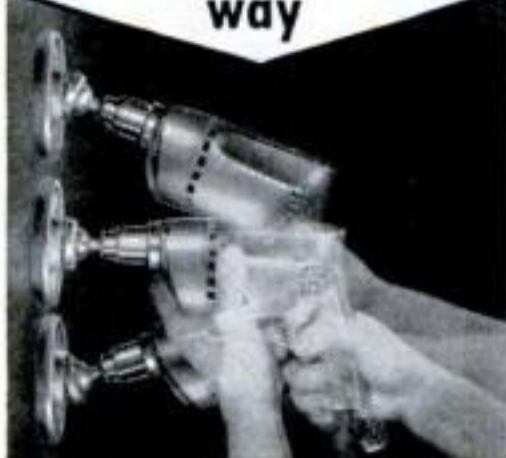
▶▶▶ I AM an apprentice crane operator. Every time I go on a new job, I bend a piece of metal lath down over the brake pedal because I know that it would take just one slip of the foot to injure someone or wreck a piece of machinery being hoisted into place. The mesh provides friction to keep my foot firmly on the pedal despite mud, grease, water or ice.—*Jack Roodman, Hollywood, Fla.*



Spiral-Hacksaw-Blade Repair

I PROLONG the life of a spiral hacksaw blade with electricians' crimp terminals. When an end breaks off I crimp a terminal on the remaining piece, restoring the blade to original length. Repeated breakages can be remedied this way, until only about half the blade remains intact.—*Mrs. Susie N. Dean, Round Lake, N. Y.*

SANDING MADE EASY
the flexible ball-joint
way



with Stanley Swirlaway

only **\$4.95** complete with 3 abrasive discs
and lambs wool bonnet

- Sands wood, metal, plastics, masonry or fibre glass
- Ball-joint eliminates gouges and swirls
- Sands with rotary planer action
- Fits any 1/4" electric drill
- No heavy pressure required—no mar, no scar

Write for folder T255.

Stanley Tools, Division of The Stanley Works, New Britain, Connecticut.

STANLEY

The Tool Box of the World

**Take it easy when
removing paint**

**USE
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Short Cuts and Tips

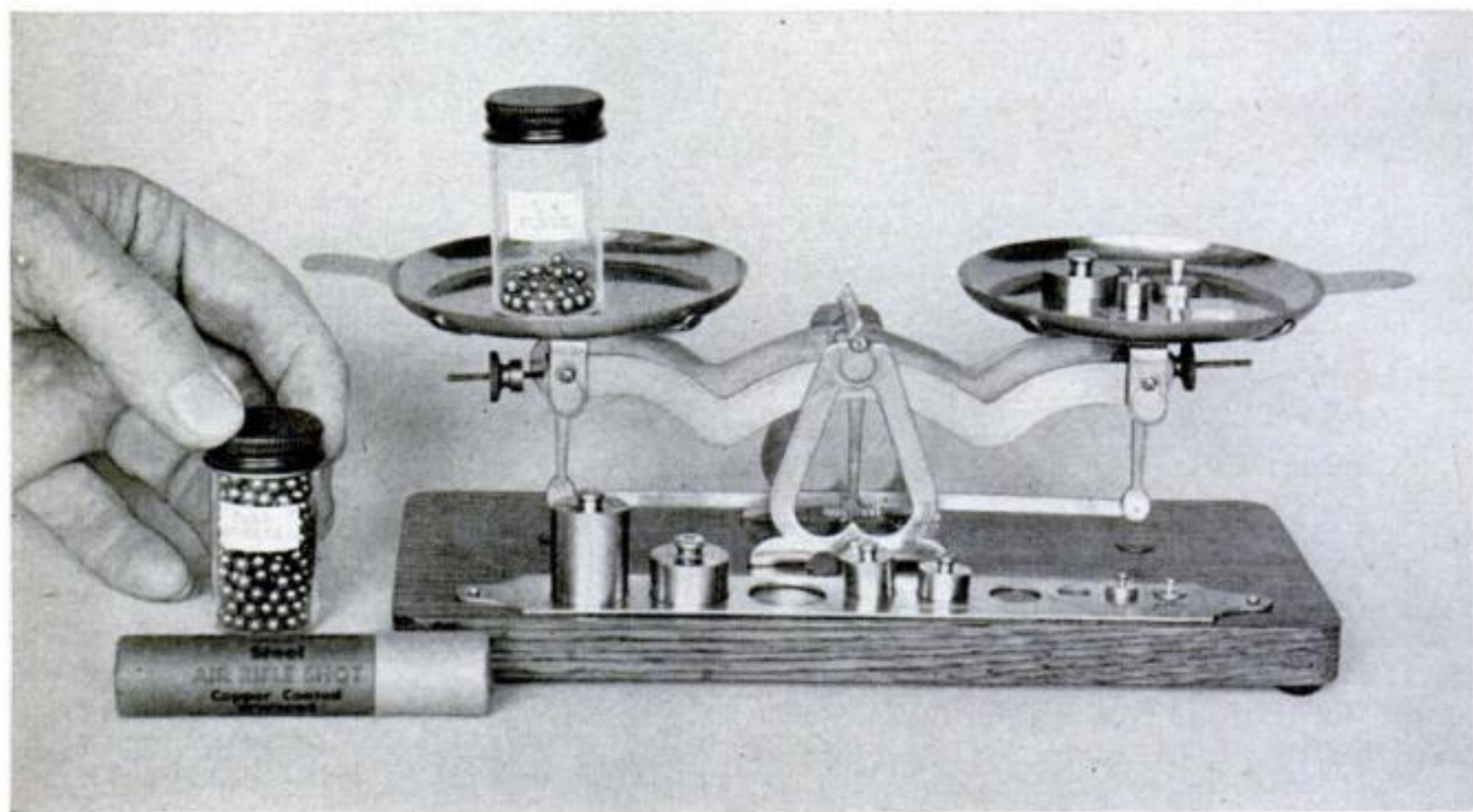
Store Electric Handsaw in Block

A TRIANGULAR block like this is a fine place to store an electric handsaw on a workbench between jobs. Drill a $\frac{1}{2}$ " hole for the blade in the long edge of the block, at right angles to the edge.—*H. T. Jamieson, Daytona Beach, Fla.*



▶▶▶SOME of my records have gotten scratched accidentally, causing the phonograph stylus to jump over into the next groove. I've found that this jumping can be eliminated by stroking the newly damaged groove with a sewing needle. The groove is clearly visible through a strong magnifying glass.—*Gerard Lietz, Chicago.*

▶▶▶THE canvas on patio furniture lasts much longer if protected by a water-repelling preservative. Before each outdoor season, brush on a coat of the preservative. Steer clear of oil bases—use the liquid that auto-supply stores carry for treating convertible car tops and tents.—*M. Peacock Jr., Radnor, Pa.*



Boost Your Scale's Capacity

You can get more use from photo scales of this type by providing extra balancing weights made with BB shot.

An additional four-ounce weight will double the capacity of most such scales, so that you can weigh small packages for

mailing. A $\frac{3}{4}$ -ounce weight is another that's good to have.

Place the weight to be duplicated on one end of the scale and a dime-store plastic container and cap on the other. Add BB air-rifle shot to the container until it balances. Then close and label it.—*O. A. Nelson, Seattle.*

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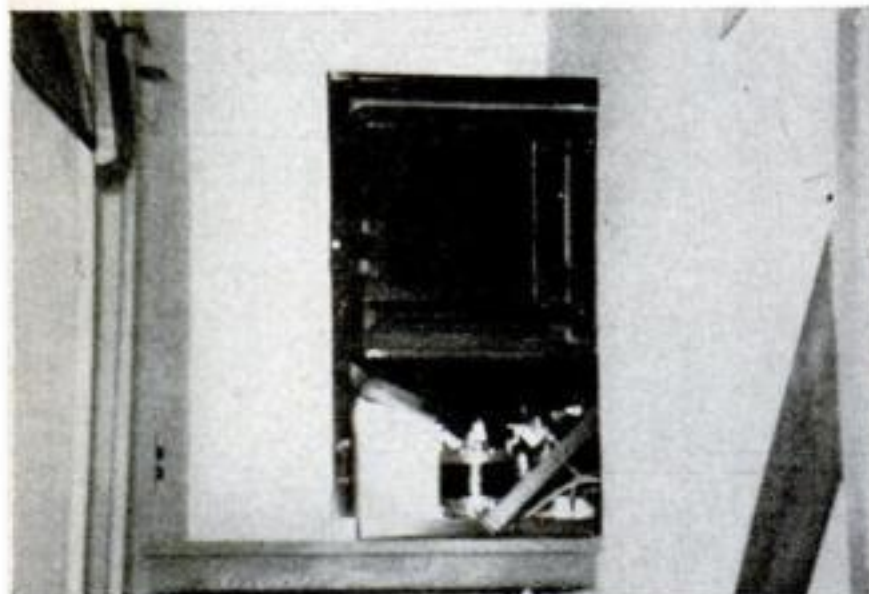
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Short Cuts and Tips



Wall-Mounted Dishwasher

THERE was no room for a dishwasher in our kitchen, but there was wasted space in an adjacent stairwell leading to the basement. So I built a sturdy platform in



the well to hold the dishwasher, and cut an opening in the kitchen wall. The dishwasher's front protrudes into the kitchen at a comfortable height for use, yet its insides are easy to get at for repairs.—*S. M. Sommers, Hicksville, N. Y.*

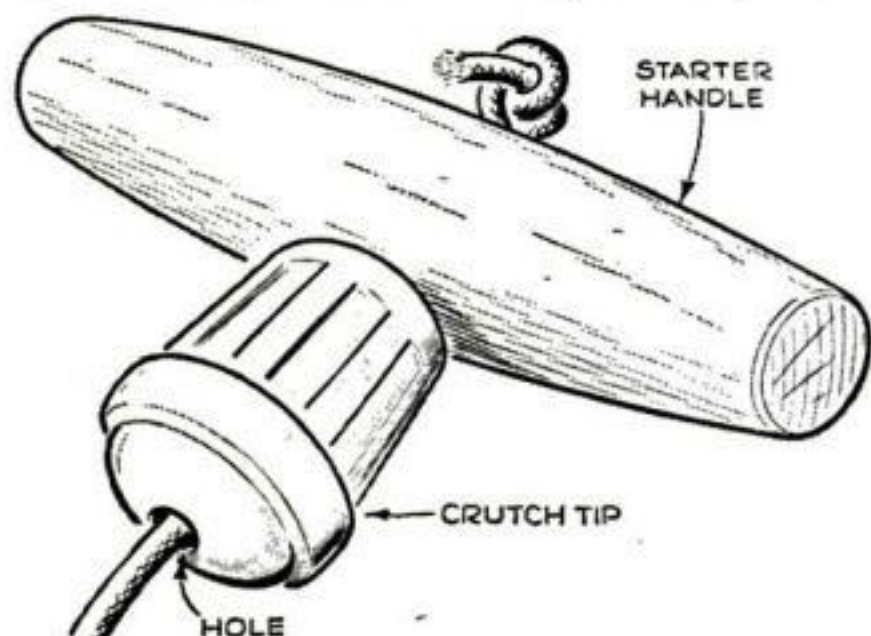


How I Salvage Solvent

SOLVENT used to clean a spray gun can be salvaged by running it into a gallon can fitted with a screw top. Over a period of time a great deal of expensive lacquer thinner or other solvent can be saved this way. I keep it for thinning or for the next time I have a spray-gun cleaning job.—*R. C. Gibbons, Oklahoma City, Okla.*

Wax Cures Sticking Window

MY WIFE complained of a stuck window. I raised it, applied paste floor wax in both channels, moved the window up and down to transfer wax to the sash. Now it opens easily.—*H. Hummer, Astoria, Ill.*



Taming a "Knuckle Buster"

YOU won't skin your knuckles starting an outboard motor, lawn mower or chain saw if there is a "bumper" on the starter rope. Punch a hole in the end of a rubber crutch tip and slip it on the rope next to the handle. Now your hand won't bang the motor if it kicks back.—*Victor H. Lamoy, Upper Jay, N. Y.*

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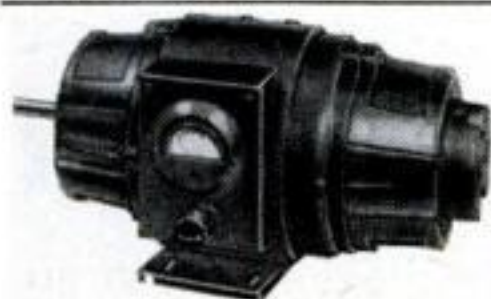
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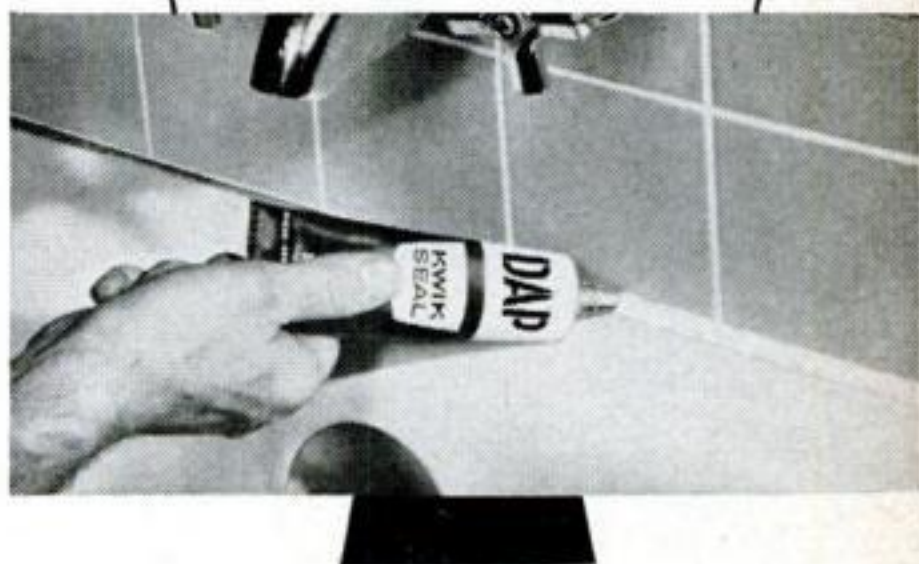
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The Car That Drives Itself

[Continued from page 79]

are linked to police headquarters by Sigalert receivers. When the cops have an urgent message for the public, the police radio dispatcher pushes a button, transmitting a tone that triggers the Sigalert equipment in the studios. A warning light goes on, and a tape recorder starts rolling to take down whatever the dispatcher says (police cars hear him directly). The studios can then interrupt their program and play the tape back to their audience.

All the experts I talked to foresee an extension of the Sigalert idea right into the car itself. Here's how they picture it:

A small transistor radio would turn on automatically with the ignition key. Permanently tuned to the highway station, it would be silent until the highway police had something to say. Then it would override your regular radio.

At first, one transmitter (or a few) would let the cops talk to everyone on the road. Gradually additional transmitters, of lower power, would be spotted along the road to limit communication to fewer cars and thus offer individualized information. One such station, for exam-

ple, might be spotted at a curve and provided with a tape that repeated to every passing car: "Sharp curve. Slow to 35."

With more transmitters, oral speed limits could supplement signs—and they could be varied to suit the weather. Later, the car's receiver might be connected to a second speedometer needle, which would automatically change to show the speed limit for each stretch of road. Eventually, the connection could be shifted to an accelerator-brake control for complete electronic monitoring of speed.

How safe can you get? By profession, Detroit researchers are dreamers. But they do not dream about human nature. They expect that new safety devices will lead many motorists to accept new risks. The net gain for safety may be small.

GM's Joe Bidwell puts it this way:

"Everybody imagines a system that will let him read a magazine while he drives a superhighway at 70 miles an hour. When we put that into a car, people will read magazines, or even lean back and go to sleep."

Chrysler's research with simulated ra-

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The Car That Drives Itself

dar braking confirms this suspicion. The simulated radar was a live engineer sitting in the right front seat. He operated an extra brake pedal the way an ideal radar would. An experienced test driver at the wheel was told that, despite the "radar," he was fully responsible for safe handling of the car and that he should use his own brake as he felt necessary.

Chrysler's safety engineer Roy Haeusler tells what happened:

"The driver let the automatic system take over. A number of potentially dangerous situations developed. For example, the driver would let the automatic control bring our car to a stop at a traffic light whenever another car had to stop in front of him. He would then tend to forget that the automatic control could not bring our car to a stop at a traffic light when it was the first car at the light."

The timetable. Such experiences, plus radar's penchant for unnecessary braking, led Haeusler to conclude:

"The complexity of the traffic problem and of human responses will indefinitely postpone a successful automatic brake."

Haeusler's opposite numbers in the other companies are more optimistic. Their feeling: Some things can and should be done to simplify routine driving, freeing the motorist to watch for danger.

I got the impression that some of these things that can and should be done are now ready to pop, in roughly this order:

1. Styling changes to increase long-range visibility (of stop lights mainly).
2. Police-to-driver radio, via present car receivers at first.
3. A proximity-warning device that will: a) blink your tail lights at another car approaching too close to you, b) flash a dash light at you when you get too close to somebody else, or c) do both jobs.

4. A real highway test of the GM-RCA system, probably arranged to display steering and braking information on dials.

None of these developments will take the decision away from the driver. They will leave actual braking, acceleration and steering to him. But they will signal him extra information so that he can make his decisions more easily and more surely.

Once these semi-automatic black boxes prove themselves on the road, it will be simple to tack on extra servos. Then you'll have the car that drives itself. **END**



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What the Satellites Tell Us

[Continued from page 87]

It explains why Sputnik I, which U. S. experts originally expected to stay up for a year or more, met a fiery end after only three months. Satellites must be shot higher, it shows, to escape air drag and last as long as intended. The new finding was announced in time for application to Explorer I and Vanguard I. Since their orbits have minimum heights of 219 and 407 miles, compared to about 150 miles for Sputniks I and II, they are expected to stay aloft for years instead of months.

Planners of future space platforms, to serve as way stations for travel to the moon and beyond, should also take notice. Some, who have been talking of altitudes as low as 150 miles for space stations, had better raise their sights.

Dog-carrying Sputnik II proved for the first time that a living creature could survive a week of weightlessness. While this had been surmised, previous "zero-gravity" experiments with animals were limited to a few minutes, in falling rockets; and just such a prolonged satellite experiment had been declared needed—by Dr. Hermann J. Schaeffer of the U. S. Naval School of Aviation Medicine.

The space-traveling dog Laika, by Soviet report, was unharmed by weightlessness. It survived for seven days, artificially supplied with oxygen and food, while instruments reported its pulse, respiration and blood pressure—until exhaustion of the power supply terminated the experiment and Laika.

Surprisingly trailing the U.S. in announcing satellites' space data, the Russians took four months to reveal scientific details of the Laika findings. What else their Sputniks' beeps had told, in secret code, the world was still waiting to hear at this writing.

Simply by observing the Sputniks' orbits and their radio signals, however, Western scientists have been able to learn a great deal.

The earth's bulge at its waistline affects the satellites' orbits, so they should tell by how much the earth's radius at the equator exceeds its radius at the poles—and whether a current Russian estimate, or a different Western one, is the nearer right. Early satellite observations seem to favor ours. But settling the question must await long study of precision photo-

What the Satellites Tell Us

graphs being made with big satellite-tracking cameras. So must measurements expected to give, more accurately than ever before, the distances between places on different continents—a matter of keen interest to missile men as well as to scientists.

Sputnik I had a "ghost." Sometimes its beeps seemed to be coming from right overhead, when it was actually on the opposite side of the world—a new and mystifying radio phenomenon. And the beeps reached radio receivers by other curious paths, more devious than direct line-of-sight. Unexplained varieties of fading were recorded. Study of these radio observations may throw new light on the nature of the ionosphere, the electrified region beginning about 30 miles above the earth's surface.

An Ohio State University scientist reported echoes of WWV radio time signals from Sputnik I—as from meteor trails, but stronger and longer. Thus he observed the sphere's final breakup, into a procession of eight fragments taking 30 minutes to sail by.

Getting the satellites' data began in near-frenzy. When Sputnik I startled the world last October 4, no one knew for sure how long it would stay up; its successful launching might be a lucky accident, not soon to be repeated. Observers must make the most of their opportunity. All night Moonwatch headquarters alerted its teams by telephone, telegraph and cable.

This had been the plan: First a satellite would be tracked by Minitrack's direction-finding radio receivers—backed up by Moonwatch's visual observers just in case the moon's radio failed to work. Then, since optical tracking is much more accurate than radio tracking, Minitrack's orbit predictions would direct our big tracking cameras to the satellite and they would take over. But that was for U.S. satellites still to come. Sputnik threw the schedule into confusion.

Ridiculous-looking little television-style aerials sprouted from Minitrack's great radio antennas. Unknown to Western scientists until a few days before the launching, Sputnik's transmitting frequencies, to our experts' consternation, were different from ours. As for the satellite-tracking cameras, the first of the 12 instruments



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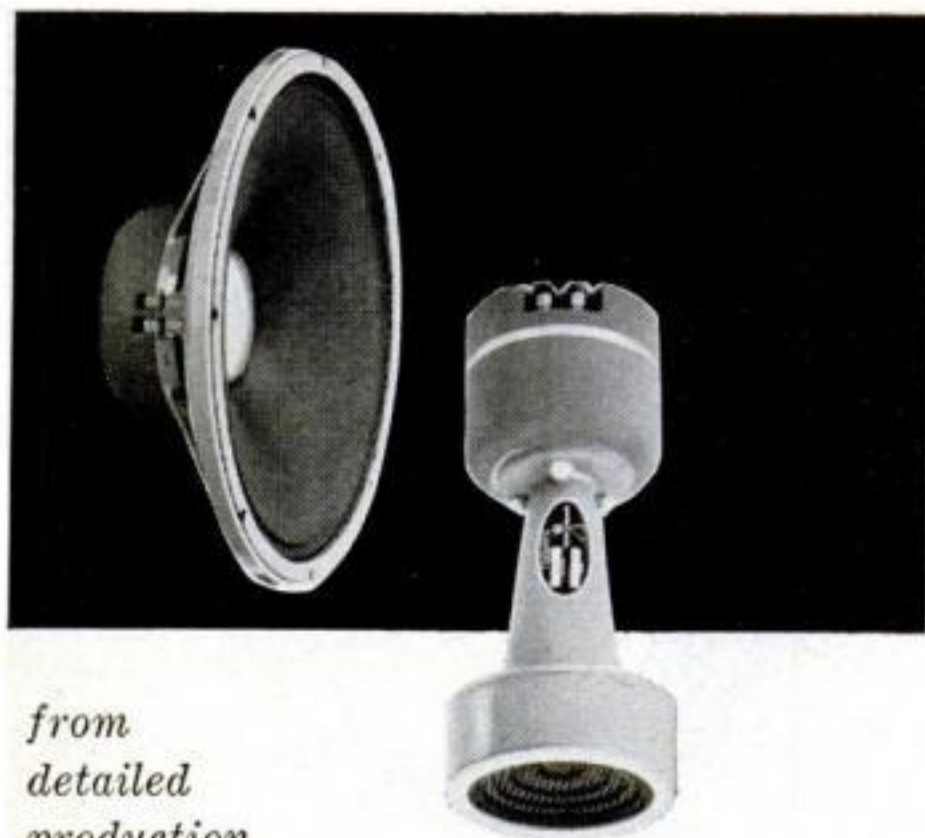
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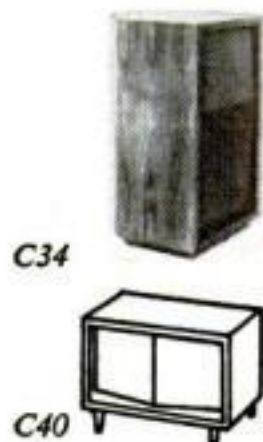


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What the Satellites Tell Us

was still short of completion at Pasadena.

So for a while it was unexpectedly up to the amateurs of Moonwatch to provide the only available precision observations of Sputnik I. And they covered themselves with glory. Not only did they come through with hundreds of scientifically useful sightings of Sputnik I's rocket, and the harder-to-see satellite itself. They even furnished nine sightings of the rocket's separated nose cone, giving the needed proof that it was also in orbit.

Radar, almost unheralded as a means of satellite tracking, proved useful here and abroad—especially in bad "seeing" weather. Hastily converted into a radar instrument, the great 250-foot-diameter radio telescope at Jodrell Bank, England, picked up Sputnik I—and, by cabled Russian request, furnished orbit data after the moon's batteries went dead.

By now, the hectic improvisations of those first days are history. The big tracking cameras have gone into action. Completed in time to catch a few photos of Sputnik I and its rocket, the first was set up in New Mexico. Others have since gone into service in South Africa, Australia and Spain; by mid-June, all 12 should be working.

Developed at once, the cameras' pictures immediately furnish data to a computer predicting a satellite's path, to help observers keep tabs on it. But the final precision measurements, and the scientific findings to result, will wait until the end of 1958 and the International Geophysical Year. Then all the photographs will be assembled at the Smithsonian Astrophysical Observatory for the painstaking task.

Meanwhile, watching the man-made moons might indirectly yield a surprise:

Will satellite observers discover any natural satellites, too fast-moving and small ever to have been seen by astronomers' telescopes, circling close to earth? Chances are considered dim, but the possibility still can't be ruled out. So the Smithsonian has been studying all reported satellite sightings that *don't* fit the orbit of any known man-made moon. If some of the offbeat data should fit together and yield a different orbit, at any moment we might hear the surprising news that nature has given our own satellites competition.

END

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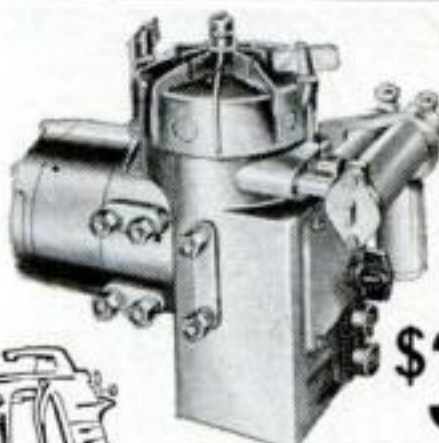


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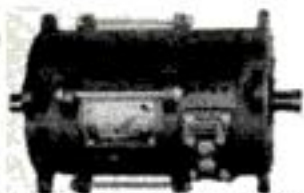
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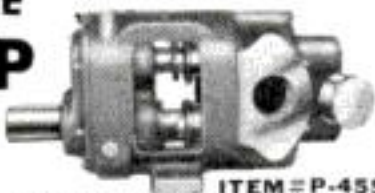
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Now Everybody Wants a Telescope

[Continued from page 97]

by the efficiency with which mirror sur-
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boo of reflectors, the frequent need to re-
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mirror. Painstaking hand correction is
required to attain this shape, so it is
more expensive than the simpler spherical
mirror. The accuracy of the mirror sur-
face is given as a fraction of a wave length
of light. A good mirror will be accurate
to $\frac{1}{8}$ wave, while an extremely precise
one may have a specification as high as
 $\frac{1}{20}$ wave. Very inexpensive reflectors
usually use a spherical mirror. In tele-
scopes with a focal ratio of f/11 or higher,
these can give you excellent performance
for the money.

A stable mount is essential for any
good telescope. Anyone who has tried to
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night will agree that at least half the
usefulness of a telescope depends on
mounting. The altazimuth mount allows
motions about a perpendicular axis for
horizontal, or azimuth, adjustment; and
about a horizontal axis for vertical, or
altitude, adjustments. It works like a
surveyor's transit. It's fine for mundane
viewing or casual peeking at the moon.
But for satisfying exploration of the stars
and planets an equatorial mount is more
convenient.

To understand how an equatorial
mount, in its simplest form, works, imag-
ine the altazimuth mount with its perpen-
dicular axis cocked at an angle so that it
is parallel to the earth's axis. You set this
by pointing it at the pole star. It is now
called the polar axis. When it is properly
adjusted you can follow any star by the
single movement about this axis.

Of course there is much more that goes
into making a good telescope, but if you
heed these pointers, you are not likely to
be disappointed with your first purchase.

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span distance with the speed of light, you
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the telescope.

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How to Boost Your Test Score

[Continued from page 129]

Some are speed tests that no one is likely to finish. So don't worry if you can't. Just keep working at top speed without stopping for second looks. Skip the hard questions and go back to them if you have time.

Tests of knowledge are worked out to let 80 to 90 percent of the average group finish. Easy and hard questions are mixed so that practically no one makes either zero or perfect; the average is slightly more than half correct.

Objective tests involve completion, matching, multiple-choice, rearranging,

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analogy and series. There are techniques for bettering your score on each kind.

- Completion tests. Look for hidden cues. The length of the blank space may hint at the length of the word you need. The phrasing may suggest a plural word. A blank preceded by "a" or "an" is a tip, too.

- Matching tests. Do the ones you know, guess the rest. Completing the first few will reduce the range within which you'll have to guess.

- Multiple-choice questions. Look for "distracters"—words that have nothing to do with the subject but sound right. Eliminating a distracter helps your odds in guessing right and often points straight to the correct answer. Here's how it works:

If answer choices to a question about angles include "abstruse" and "obtuse," you can spot "abstruse" as a distracter; it does not apply to angles. Since a distracter is meant to pull you away from the right answer, "obtuse" is a good guess—even if you have not the faintest idea what the question is about.

Sometimes you can eliminate by logic. Try this one:

American fighter planes are usually armed with machine guns of: .22 .30 .32 .45 .50 .57 caliber.

Be suspicious of the extreme answers;

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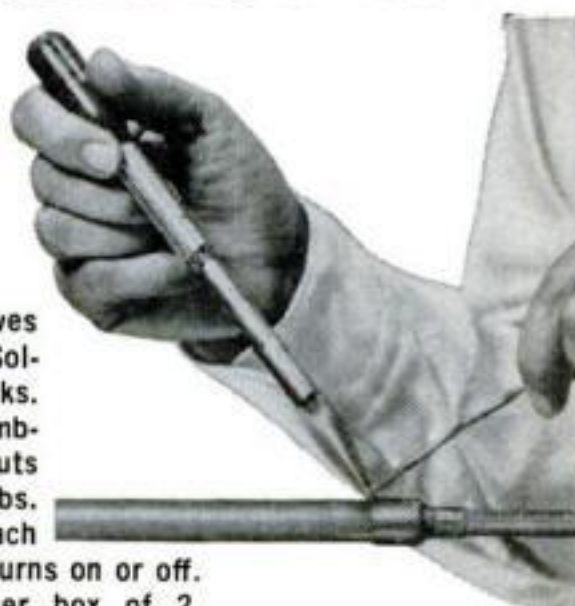
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How to Boost Your Test Score

they are more likely to be wrong. Here you may recognize .22 as target-rifle size and .57 as unfamiliar and unlikely (it's an old buffalo gun). Now, from logic, information or sheer guessing, choose among the remaining four. At worst you have a middling-fair chance of hitting right answers, because you have eliminated two wrong ones. (In case you're still in doubt, the testee was supposed to choose .50.)

It is even possible, without a trace of information, to sift out the likely answer. Here is a sample from a U. S. Naval Academy achievement test.

The action of A Tale of Two Cities takes place in:

- 1—Glasgow and London
- 2—New York and Paris
- 3—Vienna and Rome
- 4—Paris and London
- 5—Dublin and Edinburgh

Now notice: Two cities, and only two, are mentioned more than once. They are Paris and London—and "4" is indeed the correct answer.

• Rearranging items (for example: Number in order of invention the steam-

boat, trolley car, wagon, railway). Make your own list in the margin, putting in order the ones you know. Then it's easier to guess the others.

• Analogies. These are easier if you first establish the exact relationship. Here is a sample from a Naval Academy aptitude test.

Megaphone is to voice as:

- 1—atomizer to nose
- 2—electricity to radio
- 3—reflector to searchlight
- 4—electricity to searchlight
- 5—earth to heaven

Make a clear statement of the relationship between the two given words—"A megaphone projects the voice in a beam." Then you quickly see that only No. 3 contains words in the same relationship.

• True-false tests. Do the ones you are sure of first, then go back and do the rest. Don't change an answer unless you're pretty sure. First guesses are more often the right ones.

Be suspicious of flat statements that allow no exceptions. Words like "always," "invariably" or "never" usually make a statement false. Watch also for the tiny

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\$44 complete
kit less
motor

New Red Head takes the drudgery out of painting furniture, fences, siding! Cuts painting time up to 85% or more! Assures perfect results every time!

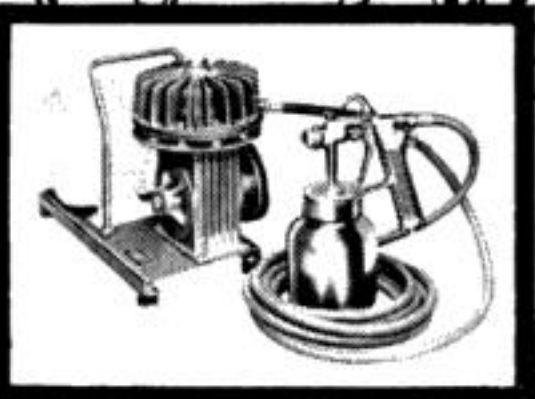
Perfect, too, for insecticide fogging, garden sprays, waxing, greasing, inflating, cleaning—has 101 uses around home, shop and farm!

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½ hp units! Red Head compressor is the most efficient ever built! Delivers clean, oil-free air at 3.5 cfm and 50 psi pressure! Plenty of power even for heavy porch and deck enamels and multi-color paints! Portable, compact—only 10" high, weighs under 30 lbs.! Uses any ¼ hp or larger motor.

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37 other models, from \$30.

JOHNSON SERVICE CO.
DEPT. M, MILWAUKEE 1, WISCONSIN



How to Boost Your Test Score

word or statement that turns a statement false even when most of it is true. "Many pioneers died in Death Valley where the climate is hot and humid" is true right up to, but not including, that last word. Mark it false!

Is it better to skip or to guess blindly?

On tests where you are simply credited with the total number of right answers, by all means guess. But most tests are scored so that you tend to break even by blind guessing. Time permitting, you've nothing to lose. The ones to beware of are those that subtract heavily from your total of right answers to penalize you for guesses that turn out wrong.

Actually, most people will get six out of 10 right even when they think they are guessing wildly. Unsuspected knowledge and subconscious logic put the guesser that much ahead of the cautious skipper.

So the try-everything testee usually comes out ahead. That's why the sporting approach helps.

As you become a master of testmanship, you'll score higher on tests, perhaps higher than your knowledge entitles you to. But for better or worse, tests are here to stay and knowing how to cope with them is one of the arts of modern living. **END**

Now how test-wise are you? These questions refer to the picture on p. 127 (don't look back now). Skilled testmen can reason out many answers even if they failed to observe some details in the picture. Answers below.

1. Which one of these things can be seen in the picture?

- A) a telephone
- B) an initialed belt buckle
- C) a list of names on the blackboard
- D) a briefcase
- E) a calendar with one date circled

2. The man in the light suit is

- A) holding a pencil in his left hand
- B) smoking a pipe
- C) holding a slide rule in his right hand
- D) pointing to the blackboard
- E) opening a loose-leaf notebook

3. The secretary in this picture

- A) wears no jewelry
- B) has a light-colored dress
- C) is writing in a loose-leaf binder
- D) wears a short-sleeved dress
- E) is looking at the blackboard

4. The man who is smoking a pipe is also

- A) pointing to a statistical chart
- B) leaning on the table
- C) wearing a bow tie
- D) writing on the map
- E) wearing rimless glasses

Answers: 1-E; 2-C; 3-D; 4-B.



We're Giving \$4200

TO FOLKS WHO KNOW HOW MANY JOBS VISE-GRIP CAN DO

... SAYS BILL PETERSEN,
PRESIDENT, PETERSEN MFG. CO



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POPULAR SCIENCE MONTHLY



Imagine asking *you* how many jobs Vise-Grip can do! But here's a tool so handy, even *we* don't know all its uses. So *every month* through October, we're mailing checks for \$200, \$100, and \$50 for the longest, practical list of uses. (And the winners' favorite tool dealers win the same amount!)

If you don't yet own one, try the new Vise-Grip with Easy Release at your hardware store. See how it locks onto work—by a hand squeeze—with 2,000 lbs. pressure! Releases with push-button ease. A whole tool kit by itself: Wrench, pliers, clamp, vise, wire cutter. A whiz for home repairs, workshop, car, hunting, boating! 7" and 10", \$2.15 - \$2.95.

Simply write your list on a plain sheet of paper with your name and address, and mail to address below.

NOTE: Decision of judges is final. Winners announced on request. All entries become property of Petersen Mfg. Co., Inc. In event of tie, full amount of prize tied for will be awarded each tying contestant. This contest open only to residents of U.S.A. and territorial possessions. Subject to federal, state and local regulations.

PETERSEN MFG. CO., Dept. PS-5, DeWitt, Nebr.

FIRST SWEDISH RIFLES IN — SALE!

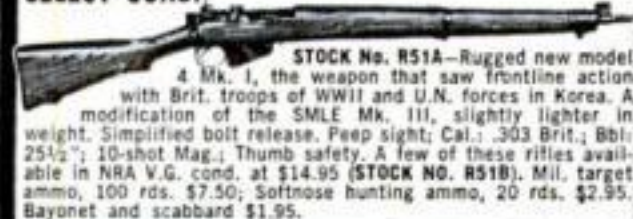
FIRST TIME OFFERED
IN AMERICA



M96 SWEDISH ARMY RIFLES \$22.50

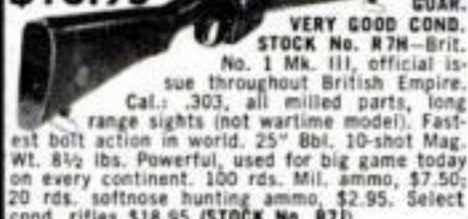
STOCK No. R44A — Famous Mauser action with Swedish precision refinements. SNIPERTYPE 5-shot bolt action repeater. Cal.: 6.5MM Swedish. Most accurate of all Mauser rifles. Many improvements over ordinary Mausers. Calibrated rear sight, blade front sight (barleycorn type) exceptional for target and hunting. These beautiful guns are available only because of recent conversion of Swedish military forces to the automatic weapons. Have been stored in ordnance depots and are in finest condition inside and out. Bbl.: appr. 29"; bores guaranteed GOOD. Select hardwood stocks. Select grade with VERY GOOD bores and exteriors \$27.50 (STOCK NO. R44B). 100 rds. fine Swedish made target ammo, \$7.50; 20 rds. soft-nose hunting ammo, \$2.95. Leather sling, \$1.95. KAR38 (short 24" bbl. version of the above rifle) NRA GOOD, \$27.50. (STOCK NO. R45A). Select specimen, \$32.50 (STOCK NO. R45B).

LEE ENFIELDS \$19.95
SELECT COND.



STOCK No. R51A—Rugged new model 4 Mk. I, the weapon that saw frontline action with Brit. troops of WWII and U.N. forces in Korea. A modification of the SMLE Mk. III, slightly lighter in weight. Simplified bolt release. Peep sight; Cal.: .303 Brit.; Bbl.: 25 1/2"; 10-shot Mag.; Thumb safety. A few of these rifles available in NRA V.G. cond. at \$14.95 (STOCK NO. R51B). Mil. target ammo, 100 rds. \$7.50; Softnose hunting ammo, 20 rds. \$2.95. Bayonet and scabbard \$1.95.

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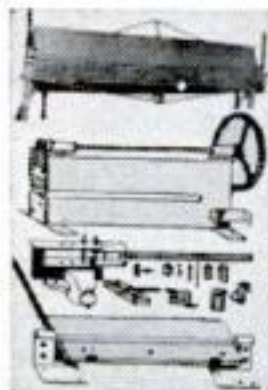
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twenty-four
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**New IRWIN
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the original solid
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**FREE! Write for the Danbury Floor
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THE DANBURY RUBBER COMPANY, INC.
Flooring Division—Danbury, Connecticut

The B-47 That Couldn't Come Down

[Continued from page 134]

would be a flat 91,000 pounds. With her wheels up, the B-47 would come in fast and stall out at a hot 105 knots.

They were opposite the end of the runway now, turning into final. He popped the approach chute and the airplane bucked and slowed.

Gradually, he bled off speed and altitude. He wished he had all of his instruments. The B-47 is partly blind when trimmed for landing, so he had to fly it partly "on the gauges." But when the canopy jettisoned, he had lost his inverters and thus all his gyros. He rolled the sleek giant out of her bank by "feel" and headed down the groove. The foam was a sickening white in the bright morning sunshine.

Suddenly, the right wing dropped. At approach speed, he dared not try to hold it up with more opposite rudder. He quickly cut engine No. 1. That would equalize the drag of the dead No. 6. He had only four good engines now.

He was within 100 feet of the concrete and flying fast. Already, the fire trucks were moving toward him.

Too much was happening at once. He reached desperately for the shut-off switches. They clicked into position and he knew that in seconds the B-47 would be a lifeless thing. The switches had cut off fuel, oil, generator, and hydraulic systems.

Gently, gently, she came down. Then, her engines starved, the B-47 lurched to earth.

Dupras hauled back on the yoke, fighting to slow her fall. He tried to reach the alarm bell. He poured his mind and body into the one final act of flaring out the big bomber that had stalled out too high.

From behind, Joe Fearnø barked, "Brace yourself, Ed."

7:31 AM

The yoke was all the way back in his guts. Then she hit—hard. Dupras popped the brake chute, but the plane barreled ahead, the concrete ripping at her belly. Flames shot out and licked up her sides. But the foam did its work. The flames flickered faintly and died.

Bob Dupras, out of habit, stomped on the brakes, but the B-47 paid no heed and

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WAR SURPLUS
EXCESS INVENTORY
BANKRUPT STOCK

6 to 12-V BATTERY WINCH



• New, powerful ball-bearing gear reduction winch. Built-in reverse switch for instant reverse 1000-2000 lb. pull. Holds up to 40' of 1/4" cable. For wreckers, boats, trucks, trailers, etc. 18"x9"x7". Wt. 50 lbs. Govt. cost \$280. SALE.....\$49.95 FOB

IRRIGATION PUMPS

2 1/2" size... 16,500 gph



• Brand new all bronze ball bearing centrifugal pump. Ideal small farm and garden irrigation, many industrial uses.
• 2 1/2" inlet. Capacity to 280 gpm. Pressure to 65'. Speed 1200-2700. Used 3/4 to 5 HP motor. Size 10"x11"x9". 6" pulley, 2" outlet. Wt. 40 lbs. Govt. cost \$100. SALE.....\$49.50 FOB

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• Ideal for golf or midget car. Use 6 or 12-v auto battery. Output speed 25 to 80 rpm. 1 1/2 to 2 1/2 HP. Geared 140-1. Easily reversible. 100s other uses. 14" long, Dia. 7". Shaft 3/4". Wt. 35 lbs. Govt. cost \$250. SALE.....\$18.95 FOB

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• Hand wheel gives infinite speed control from 0 to recommended input speed of 750 rpm. Instant reverse at and speed. Ideal for milling machines, lathes, midget cars, hand saws, conveyors, etc. 12" long, 8" wide, 9" high. Wt. 30 lbs. 3/8" shafts. Govt. cost \$400. SALE \$49.50 FOB

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• New, unused, 3000-w 115-v 60-c AC power plant with 4-cyl. water cooled Hercules engine. Push button starting, weather proof housing. We were recently awarded these popular M-5 plants by a Naval Supply Depot and are passing the savings on to you. 48" long, 20" wide, 30" high. Wt. 800 lbs. Govt. cost \$1248. SALE.....\$329.95 FOB Transformer for 115-230-v power...\$27.95 FOB

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• Brand new hi-capacity, small centrifugal. Operates on 12 or 24 volts AC or DC. Ball bearing, explosion proof motor, up to 8 gpm. 7"x3". Outlet 1" OD. Wt. 7 lbs. Excellent bilge pump, cellar drain, water displays, etc. Govt. Cost \$64. SALE.....\$9.95 Ppd.

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10" TILT/ARBOR SAW BUILD-IT-YOURSELF from GIL-BILT KITS-PLANS

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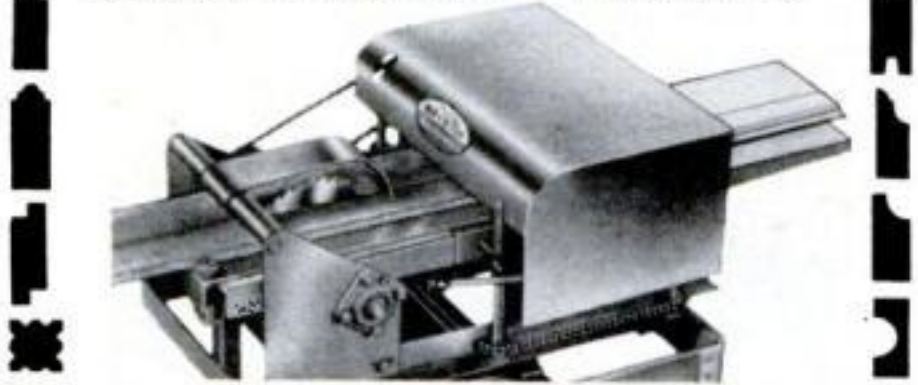


1,001 uses. Stainless shaft. Won't rust or clog! Uses 1/6 HP motor or larger... 3/4 HP for up to 3000 GPH; 450 GPH 80' high; or 1800 GPH from 25' well. 1" inlet; 3/4" outlet. Coupling included free. Heavy Duty Ball-Bearing Pump. Up to 7,500 GPH. 1 1/2" inlet; 1" outlet. \$7.95 \$12.95

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No Hands



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BE SURE IT'S
A GENUINE
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LOOK FOR THE
TRADEMARK
ON THE HANDLE

CHAMPION DeARMENT TOOL COMPANY
MEADVILLE, PENNSYLVANIA

242 POPULAR SCIENCE

The B-47 That Couldn't Come Down
skidded on. Now the fire trucks were screaming in. Behind them came the ambulances.

Exactly 28 seconds later, after skidding 2,200 feet, the big plane ground to a halt.

Joe Fearn scrambled out of the cockpit, climbed up on the wing and ran out toward its tip. Dupras followed. At the same instant, Wieland blew his safety hatch and slid down the nose.

In 15 seconds, the fire trucks had skidded to a halt beside the plane and covered the engines with foam. The flight was over.

10:21 AM The B-47 came to final rest outside the 544th's maintenance hangar. The maintenance chiefs who studied the landing gear found that a broken lock-pin had jammed the main gear. It was the first time in the history of the B-47 that the piece had given trouble.

Next day, Sept. 6, Capt. Dupras was recommended for the Distinguished Flying Cross, and Lt. Fearn and Capt. Wieland were recommended for Air Medals for "superb airmanship and exemplary conduct befitting the crews of the Strategic Air Command."

Next day, also, a wingmate said to Dupras, "What the hell, if you guys were so hungry, why didn't you eat the food in the survival kits under your seats?"



END OF AN ORDEAL: B-47 No. 52220—her 45 tons back on solid ground and coated with fire-smothering foam—after the wheels-up belly landing at Little Rock Air Force Base. **END**



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Super Filer No. 11 joints and sharpens hand and circular saws 6" to 10" with all teeth correct in height, depth, pitch, bevel. When file hits hardened steel roller, teeth are finished. Saw runs true with no side pull. Includes 8" file. **\$9.95** ppd.

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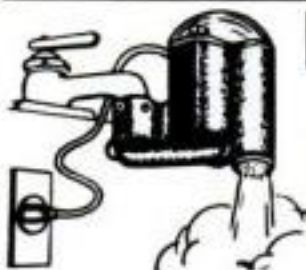
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SUPERSHOP includes precision-built 8" tilting table saw, vertical and horizontal drill press, 30" lathe, sander, grinder. 100% BALL BEARING. Write for FREE catalog, full details, trial plan.

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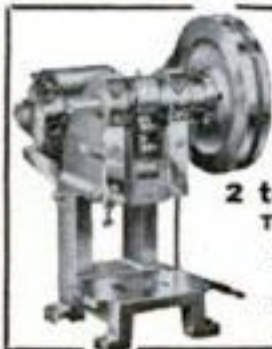
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Instant hot water for just pennies—You just slip MASTER MECHANIC'S new Faucet Water Heater over any faucet—plug it in a wall outlet and you've got steaming hot water instantly for dishes, shaving, washing baby's bottle, etc. Simple and safe—operates on ordinary 110 v. house current—costs only 2 1/2 cents per hour for hot water. Ideal for homes, shops, cabins, trailers, etc. Easily regulated from lukewarm to full hot. Fully guaranteed. (Item 408) Wt. 2 lbs. **\$4.95** Factory price.

Send 10c for 100 page Catalog—FREE with order. Prices f.o.b. factory—Send check or M.O. MASTER MECHANIC MFG. CO., Dept. B-58, Burlington, Wis.



Heavy Duty Bench Type ALLEN PUNCH PRESSES

Model B-2
2 ton - **\$97.50**
Tilting model
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fob-less motor

164 Different Model Combinations
1 to 5 ton capacities
Moderate in price
Fully guaranteed

See your supply dealer or write for Free catalog giving complete information and prices on our Bench Type Punch Presses.

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ONE BIT FOR ALL

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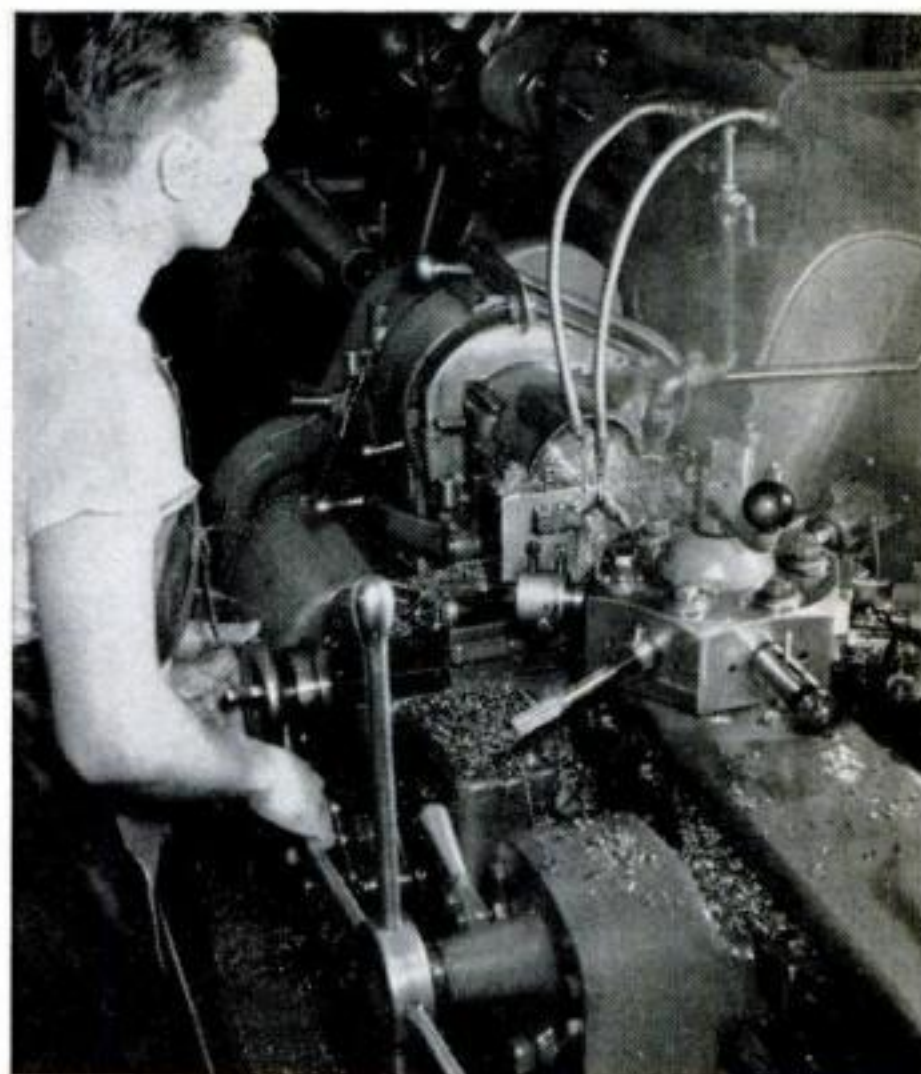
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- Responsive and easy to handle.
- Rigid for vibration-free operation.
- More usable power.
- Exceptionally wide ranges of spindle speeds, power turret feeds (handlever feed only on 10" lathes), threading feeds, longitudinal and cross feeds.

SPECIFICATIONS and PRICES

Turret Lathe Model	10"	13"	2-H
Swing over bed	10 1/8"	13 1/8"	16 1/4"
Collet capacity	1 1/16"	1 1/8"	1 1/16"
Spindle bore	1 3/8"	1 3/4"	1 3/8"
Turret feeds	hand	144	144
BASE PRICE	\$1748	\$2560	\$3658

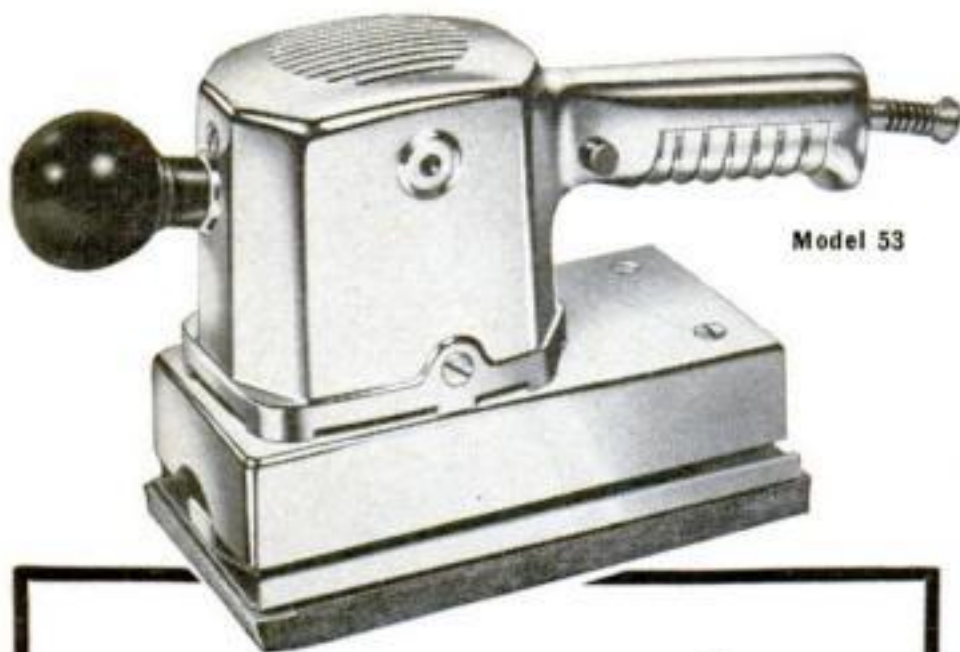
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Literature

The New Outboards

[Continued from page 161]

that stops the engine when it kicks up out of water to keep the prop from running wild, then restarts it when the prop returns to operating position. Test motors have been driven over floating telegraph poles and sand bars at full speed with no damage or loss of steering control.

Both Johnson and Evinrude use a single twin-barrel down-draft carburetor. A thermostat maintains proper temperature in the cooling system at all speeds.

The V-4s are available with either manual or electric starting. In the electric version, a switch key lets you lock the motor so it can't be started by anyone else when you're away.

Debut of a diesel. Also new this year is a revolutionary diesel outboard introduced by American Marc Inc., Inglewood, Cal. So new is this power plant, in fact, that details are available only on a 7½-hp. model, although the company plans to produce 15- and 22-hp. motors.

The 7½-hp. model has a displacement of 18.5 cu. in. It is a two-cycle, crank-case-scavenged engine that is typical diesel in some respects, but unique in other ways. Like a diesel, it is simple to maintain because it requires no carburetor, magneto or spark plugs. It is inexpensive to run (two quarts fuel per hour at full throttle) and has less fire hazard because it burns low-cost, inert diesel oil.

But unlike most other diesels, it has an unusual method of precombusting the fuel, which does away with conventional, bulky diesel combustion chambers, and a novel arrangement of opposed-firing pistons in a single cylinder. These unique features keep both weight (80 lb.) and size unusually moderate for a diesel. Price: about \$325.

On the foreign front, one of the most interesting motor lines is the British Seagull, imported by various agents in the U. S., among them the Sea Bright (N. J.) Marine Center.

All Seagull motors—which range from 1½ to five hp.—are lightweight, smooth-running, single-cylinder power plants with large reduction gears and big, slow-turning, four-bladed propellers. These ponderous props provide steady thrust that is perfect for driving such heavy, comparatively slow displacement craft as keel sailboats and houseboats. **END**

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Approx. Gov't Cost . . . \$76.00
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(While the A-bomb will have made the dust radioactive, a tiny amount sufficient for analysis should be no problem on that score.) The second rocket will then use auxiliary jets to move it back into a trajectory that will return it to earth.

The returning rocket will move into the earth's atmosphere at high altitudes, and then the flight path will be depressed 10 degrees to the horizon. Since it is moving at about 35,000 f.p.s., the moon rocket would risk incineration, and to prevent this some novel way of ejecting the instrument capsule may be devised.

Perhaps the capsule will be coated with an unusually heat-resistant plastic such as Teflon (as has been suggested by Dr. R. W. Porter) so that the heat could "boil off" the Teflon without burning up the capsule. Or perhaps deceleration jets will be used. After the capsule has decelerated to a nominal speed, parachutes could be used to land it. A small radio transmitter in the capsule can emit a signal to help locate the fallen capsule. That is one way of recovering physical data from the moon, though at this moment the problems are of staggering complexity.

2000: Man on the moon

The last step, putting a man on the moon, will take a long time. It requires the erection of a full-scale space station to circle the earth at an altitude of at least 1,075 miles. At this space station the necessary materials can be assembled for the man-carrying moon rocket.

One reason for the space station is that, orbiting the earth, it has a speed of almost 4.4 miles per second (15,840 m.p.h.). An additional speed of hardly more than one mile per second is needed to pass from the preponderance of the earth's gravitational field into that of the moon's. Including the additional tasks of braking for a moon landing, and taking off again, the total performance required of a rocket in a space-station-to-moon round trip is less than for a trip from the earth to the space station!

The manned vehicle will not look like a conventional streamlined rocket. This one will take off and land on places with no atmosphere, which makes streamlining unnecessary.

Leaving the space station with a speed

of about a mile a second, the rocket heads for the moon. It will reach a point, 23,600 miles from the moon, where the gravitational fields of the earth and moon balance each other. The manned rocket will then begin its descent. Because of the practical lack of an atmosphere, rocket power alone must brake the fall.

Once man has set foot on the moon, data previously obtained in a rough way with his robot rocket can be definitively checked to determine the density and composition of any lunar atmosphere. Lunar temperatures can also be precisely determined.

The astronomers will have a field day resolving some of the moon's mysteries:

- What are the lunar rays? First-hand inspection of these long-unexplained bright streaks on the surface may reveal their nature and origin.

- How did the giant lunar craters come into being? Were they created by volcanic activity, or by the impact of large meteors?

- Is the moon a daughter of the earth? Was the moon torn from the earth by some giant cataclysm in the long ago? Perhaps a comparison of the rocks on the moon with those ringing the Pacific Ocean will provide the answer.

When can we expect these answers?

This writer believes that we will have to wait until the turn of the century. Unless a tremendous amount of money is available—or, better, resources are pooled in an international project—a manned landing on the moon cannot be consummated for a long time. It is unlikely that the space station will be built before 1978. After the space station is finished, years will be needed to plan, build and assemble equipment for a landing on the moon.

Why so much time? Manned reconnaissance of the moon will be necessary to pick the landing area. After the reconnaissance, small rockets will be dropped to the lunar surface to yield information as to what lies immediately beneath the surface in the chosen area. Finally, it will take time to assemble and test the giant moon rockets. Only when this is done will man take off for the moon. When he lands, man's first conquest of space will have begun.

The year will be 2000 A.D.

END

This One



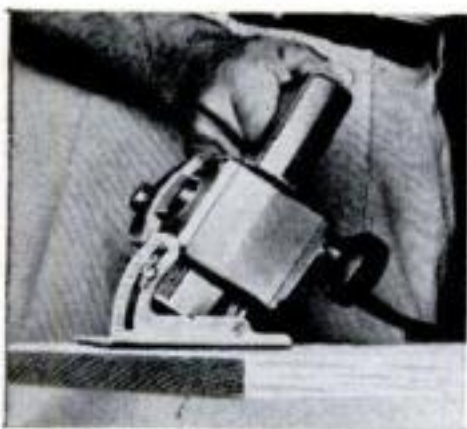
KF8J-2WX-EX5A

Look

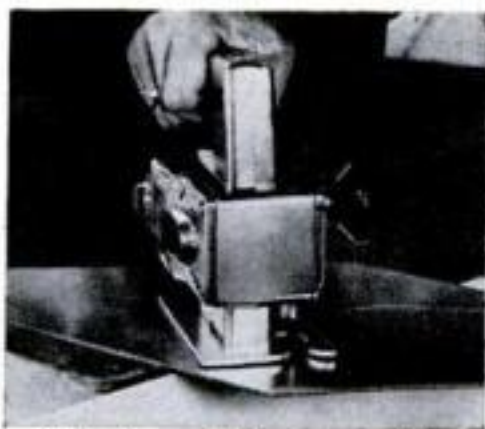
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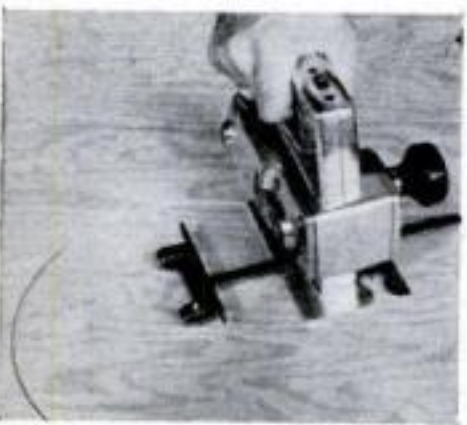
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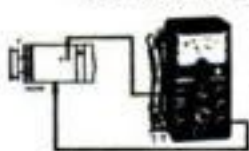
Small electric fan motor indicates 50 ohms (normal resistance).



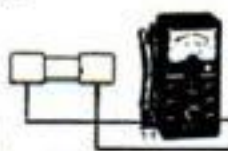
Control circuits of most furnaces use 24 volts obtained from step-down transformer. Here's how to check room thermostat to see if wires to it are live.



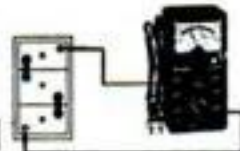
Manual supplied with Model 70 shows meter needle moves to right when test leads are connected to pins 3 and 4 of this 6AU6 tube. Procedure for testing all tubes used in TV are detailed in manual.



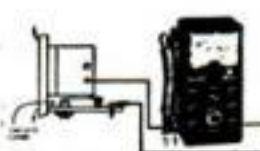
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